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Including SOUTHERN AVIATION and AERONAUTICS

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XUM

How America's Naval Aviation

by JOSEPH S. EDGERTON

Compare this Curtiss seaplane of ancient vintage to today's sleek, high-powered naval craft. But this frail box kite did more than its share to make American naval aviation what it is today.

IN the warm sunlight of a calm Summer day in 1911, a group of Navy officers and some scores of midshipmen stood on the shores of the Severn River in front of the Naval Academy, Annapolis, Md., to watch the launching from a cable stretched above the shore at Greenburg Point of a Curtiss pusher biplane.

Behind the observant officers and the youngsters of the Academy rose the stately buildings of the great institution, the citadel of Navy conservatism and tradition. It is altogether fitting that the first flight of a Navy pilot in a Navy airplane should have been made in the shadows of those austere walls, for the early struggles of naval aviation were waged against the traditions and conservative policies of the Old Navy.

So, on that Summer day 25 years ago, the Curtiss, with Lieut. T. G. Ellyson, Naval Aviator No. 1, at its "front porch" controls, delivered the first tentative tap at the shell of conservatism and tradition into which the Navy had crawled. Before the Summer was over there were four naval aviators at Greenburg Point and they were beating a vigorous tattoo on the Navy shell, soon to reach the breaking point.

The group of watchful officers, for the most part instructors in the century-old cradle of Navy tradition, were interested in the aviation experiment being unrolled before their eyes but perhaps no more than they would have been in any other difficult and sporting effort by one of their number. It is possible they were secretly amused that the Navy should be taking so seriously this new-fangled flying machine.

It is interesting to imagine what might have been the reactions of those officers had you told them that within 25 years the successors to that airplane would have become a vital factor in the life of every naval officer; would affect every phase of naval strategy and tactics, and would bring into the Navy a strange fleet of most unorthodox vessels, the carriers and aircraft tenders; or if you had suggested to those eager-eyed young midshipmen that within less than a quarter century every midshipman to pass through the Academy would be flying as a part of his regular training.

Yet the 25 years which have elapsed since that 1911 flight have witnessed the growth of aviation into its present status as one of the most important elements of the Fleet.

In 1911 the Navy received its first aviation appropriation, bought its first airplane, trained its first pilots and made its first flight. It established its first aviation camp and the first airplane landing was made on a war vessel. The Silver Anniversary of naval aviation finds the naval air force of this Nation in a position of recognized world leadership among the naval air powers. Truly, a quarter century of strange changes and astonishing growth for the Navy of tradition!

Despite the hazards of those early days, when every flight was an experiment and adventure of high order, there are pioneers with 20 to 25 years of flying behind them still in active service. Of the earliest naval aviators—those of 1911 and 1912—four still hold active aviation assignments.

They are Capt. John H. Towers, now Naval Aviator No. 1, who today is chief of staff to the commander, Aircraft Battle Force; Capt. Patrick N. L. Bellinger, now commander of the Navy's newest aircraft carrier, the U. S. S. Ranger; Comdr. Earl W. Spencer, executive and second in command of the Ranger, and Capt. Kenneth Whiting, now in command of the Fleet Air Base, Pearl Harbor, Hawaii. Another of these first Navy pilots, Comdr. H. V. Herbster, retired last year.

The Navy first took official cognizance of the airplane in 1909, when Lieut. G. C. Sweet and Naval Constructor McIntee were detailed as observers at the tests of the Wright biplane for the Army at Fort Myer, Va., in 1909. Sweet tried to interest the Navy in acquiring an airplane for tests with pontoons, but nothing came of his efforts.

A year later Capt. W. I. Chambers, U. S. N., assistant to the aide for material in the Bureau of Equipment, Navy Department, was sent as an observer to the aviation meets of 1910 at Belmont Park, N. Y., and Halethorpe, Md. Chambers was destined to play a long and important role in naval aviation. He rose to the rank of

It's Glenn Curtiss himself and the year is 1909. This rickety looking contraption was the last word in those days and Curtiss was considered one of the most outstanding aviation men of the day. Which he was.

Got Its Start—And Who Did It

rear admiral before his retirement and subsequent death, about two years ago.

Chambers appreciated the potential value of the airplane and tried to interest the Wright brothers in making a flight off a warship. They refused and Chambers went to Glenn H. Curtiss, who agreed to sponsor a trial. On November 14, 1910, the Curtiss pilot, Eugene Ely, flew a 50-horsepower Curtiss landplane from a platform built on the U.S.S. Birmingham at Hampton Roads, Va.

Curtiss offered to instruct one or more naval officers free of charge, as the Navy had as yet received no funds for aviation. Lieut. Ellyson went to the Curtiss camp at San Diego, Calif., on December 23, 1910, largely "on his own," and became the first naval officer to learn to fly.

Naval aviation's birth year dawned brightly. On January 18, Ely, then at the San Diego camp, made a landing on a platform built on the U.S.S. Pennsylvania, lying in San Francisco Harbor. The next day he took off from the platform and flew back to shore. During that month Curtiss and Ellyson perfected a pontoon attachment for the Curtiss biplane and the first seaplane was given to the world.

With this seaplane, on January 26, Curtiss flew from the water at San Diego, landed alongside the Pennsylvania, was hoisted aboard and later was lowered overside and flew back. These two flights gave naval aviation development a great impetus.

Chambers' report was given serious consideration and Congress, early in 1911, appropriated $25,000 for naval aviation for the fiscal year beginning July 1, 1911. On March 13, 1911, Capt. Chambers was assigned to the Bureau of Navigation and directed to give his full time to aviation development. He met with a rather chilly reception from the old Navy—a fact which the Navy itself admits frankly. There is an illuminating paragraph in official Navy records:

"This officer struggled with the many difficulties which always present themselves to those to whom fate assigns the difficult task of injecting new ideas and a new activity into a staid and elderly organization. The Navy as a whole was not interested and Capt. Chambers worked alone and unassisted to build up a naval aviation establishment."

Fearless looking Eugene B. Ely, the famous pioneer airman, is shown here just before taking off from the deck of the U. S. S. Pennsylvania in San Francisco harbor. Though Ely appears smilingly unafraid, he's nevertheless well supplied with inflated inner tubes around his shoulders—just in case the flight between the ship and shore be interrupted.

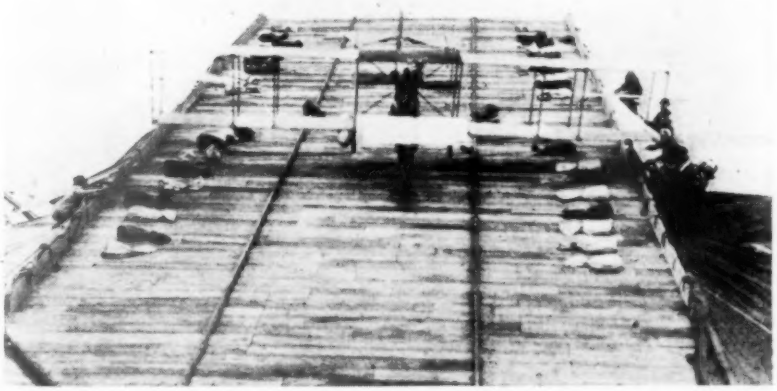
Early in 1911 Lieut. John Rodgers, Lieut. John H. Towers and Ensign V. D. Herbster were ordered to the Curtiss and Wright camps for flying instruction. They became Naval Aviators Nos. 2, 3 and 4, in the order named. Ellyson, No. 1, was killed in an airplane accident at Norfolk, Va., February 29, 1928. Rodgers, No. 2, was hero of the first attempted flight from the United States to Hawaii, in 1925. He later became assistant chief of the Navy Bureau of Aeronautics and also gave his life in a crash at Philadelphia. This left Towers as No. 1 of the living pilots.

With the first appropriation, the Navy bought two Curtiss biplanes and one Wright biplane. The Annapolis camp was opened and there Ellyson made the first flight. The first notable flight by a naval pilot was in the Autumn of 1911, when Lieut. Rodgers flew from Annapolis to Washington and to College Park, where the first Army airdrome had been established. He returned to Annapolis by way of Baltimore and Havre de Grace, Md.

Soon afterward Ellyson and Towers flew from Annapolis down the open waters of Chesapeake Bay to Fortress Monroe, Va., and return. This closed the Annapolis season. For the Winter months of 1911-12, naval aviation was transferred to San Diego. One of the photographs accompanying this article shows the San Diego camp, with two Antoinettes and three Curtisses in the picture. Activities were resumed at Annapolis in 1912.

During 1912 the Navy's four original pilots were joined by Naval Constructor Holden C. Richardson, Lieuts. (junior grade) G. de Chevalier, Patrick N. L. Bellinger and W. D. Billingsley and First Lieuts. A. A. Cunningham and B. L. Smith, U. S. M. C. "Dick" Richardson was to become one of the most noted of Navy flying boat designers. Today, as a reserve officer on extended active duty, he is in charge of the Patents Section of the Navy Bureau of Aeronautics.

Bellinger is No. 2 of living Navy pilots to-day. Billingsley was the first naval officer to die in an airplane accident. While flying with Towers, he was catapulted out



Here's action of the first order. Eugene Ely is shown landing on the deck of the U. S. S. Pennsylvania in San Francisco harbor on Januury 18, 1911. A hook on the ship's tail scoooped up the ropes between the sandbags and dragged Ely to a stop. Next day he took off the deck for shore.

XUM

of the open seat into Chesapeake Bay on June 20, 1913. Development of the safety belt was a result. None of the others in the 1912 group remains in aviation. Chevalier is dead, Cunningham retired and Smith resigned.

During 1912, Towers established a world endurance record of 6 hours 20 minutes. This year also brought the catapult, designed at the Naval Gun Factory, Washington Navy Yard, under supervision of Capt. Chambers. The first attempted catapult take-off, by Ellyson, was unsuccessful.

The catapult was redesigned by Richardson and Ellyson was successfully catapulted October 12, 1912, from a float at the Washington Navy Yard. During 1912 the Navy also constructed at the Washington Navy Yard what was for many years the world's largest wind tunnel, the first of modern type.

Naval aviation went to sea in January, 1913, when the detachment was transported from Annapolis on a Navy collier to Guantanamo, Cuba, to operate with the fleet for the first time. From the Cuban camp, commanded by Towers, numerous flights were made to test the employment of airplanes in cooperation with ships. Several notable flights were made along the Cuban coast and aircraft demonstrated its worth in scouting. After the maneuvers, the detachment returned to Annapolis for the Summer of 1913.

There another group of students arrived for aviation training—Lieut. Comdr. H. C. Mustin, Lieuts. (j. g.) J. M. Murray, R. C. Saufley and M. L. Stolz; Second Lieut. William McIlvaine, U. S. M. C.; Ensign W. D. Lamont, and J. B. Rockwell, a Navy civilian engineer. Mustin became commander of the first Naval Air Station, rose to the post of assistant chief of the Navy Bureau of Aeronautics in 1922, and died about 10 years ago in a crash. Murray was killed February 16, 1914, at Pensacola; Stolz died in a crash May 8, 1915; Rockwell in a crash in California May 24, 1916; and three weeks later Saufley died during an endurance flight in California. McIlvaine has left the service.

In June, 1913, Ballinger established a world seaplane altitude record of 6,200 feet in a Curtiss. Lieut. Smith made the first amphibian flight. Richardson, in 1913, conducted a series of model basin tests on seaplane floats and hulls which, according to the Navy Department, "have proved to be perhaps the most important and fruitful research ever undertaken by the Navy."

Naval Constructor Jerome C. Hunsaker was sent to Europe at this time to make a study of European aviation and then was assigned to the Massachusetts Institute of Technology, where he installed a wind tunnel and established a course in aeronautical engineering.

In October, 1913, a Board of Aeronautics was appointed by the Secretary of the Navy, with Chambers as chairman. This board outlined a development policy, one of the recommendations being for establishment of a Naval Air Station. The plan was approved and in January, 1914, the station was established on the site of the abandoned Navy Yard at Pensacola, Fla.

(*Continued on page* 56)

NEW BEN JONES SPORTSTER

Trim and fast, this new little ship can get 151 m.p.h. top speed out of its 125 horsepower Menasco engine. It's intended for the private or sportsman pilot and should be an attraction in that field.

DO you think it resembles an A-12 attack?

Ben Jones, Inc., operating at Schenectady, N. Y., County Airport, has manufactured its Model S-125 as a particularly attractive ship for the average private pilot.

The fuselage is of tubular frame construction. There is metal fairing from the firewall back to the trailing edge of the wing and then fabric covering extends back. The front fuselage metal covering may be removed. The inside finish is leather, trimmed with welting. There are back cushions on the seats and arm rests, housing baggage pockets, for both front and rear cockpits. Baggage space is to the rear of the pilot and is accessible from the cockpit.

Instruments are on the rear panel only but there is also space for a set of duplicate instruments in the front cockpit. There are visual fuel gauges on either side of the fuselage just below the pilot's knee. The shut-off valve, wobble pump and strainer valve are in the rear cockpit at the right, along with the parking brake.

There are dual controls. Rudder pedals, which are pivoted below the floor, are provided with rubber padded brake control pedals on the outer side. In this manner either brake may be operated separately, or together, without using the rudder pedals.

The full cantilever tail surfaces are of all-wood construction and the elevators and rudder are of dural frame structure with fabric covering. The wings are of two box spar design and are covered with plywood and fabric. The modified Frieze-type ailerons are cable controlled to bell cranks with the push-pull rods operating through rocker arms. Two fuel tanks, which hold 23 gallons each, are carried in the wings and may be conveniently removed through the bottom of the wing.

The cantilever type landing gear, with individual legs completely faired, consists of a fork fixed to a shock strut. This is braced and guided by a tripod fixed to the front spar and a tubular truss between the spars. The wheel with brake and axle is easily fixed to the fork axle terminals which are U shaped.

Torque from the unsymmetrical wheel loads is transferred by the fork to the tripod by a sliding tube which interconnects the two units. The 8 inch tail wheel has a 360 degree swivel and incorporates a steel coil shock spring and pneumatic damper for rebound.

The engine, which is detachable, is mounted in rubber and has a venturi type cowl. The ship is equipped with a 125 or 150 h.p. Menasco engine. There are no

(*Concluded on page* 60)

Plenty of clean lines topped off by the smooth cowling job made possible by the air-cooled in-line Menasco engine. The sliding cockpit cover makes this an all-weather plane.

Bellanca, Builder Extraordinary

by JACK ROBINSON

If any living man can competently forecast aviation's likely status in 1960, it's Guiseppe M. Bellanca, builder of the airplane that has made aeronautical history in many ways

KNOWN as "the man who designed the plane in which Chamberlin and Levine spanned the Atlantic," G. M. Bellanca needs no introduction to airmen and air fans. His uncanny knack for producing super-planes that give "tomorrow's performance today" has won him the acclaim and respect of the entire aviation industry.

It is no accident that planes of his design have four times won the National Efficiency Races or that a plane built by him still holds the World's Non-refueling Endurance Record. This modest Italian-born genius is a man of rare vision. I believe that no one in the industry is better equipped than he to foretell aviation's glamorous future.

At the executive desk in his modern aircraft plant in New Castle, Delaware, we recently talked of tomorrow's aeronautics —of flying in 1960, to be exact. At intervals he stroked his forehead with his long artistic fingers and buried his face in the palm of his hands as if to shut out all distracting thoughts of a drab today and peer across the misty horizon of time to see the flying wonder-world of tomorrow. "Ha! It's a little like dreaming," he remarked with disarming frankness.

Our discussion finally drifted to the mighty airliners of a few years hence.

Q. How large do you think they will be built eventually?

A. "I can see round-the-world airliners as large as two, four, or even five hundred passenger capacity. I believe that about five hundred passengers is the ultimate limit as larger liners would have a tendency to be unwieldy and would lack the flexibility of control that smaller units would possess.

"I imagine that larger clippers will be built. Sometimes we build large things merely to impress. However, for universal, practical use I think the airliners of a limited five hundred passenger capacity will predominate."

Two tons of payload on one engine! That's a common Bellanca practice and this Cyclone-powered Aircruiser is doing just that up in Canada today. This ship, owned by the Mackenzie Air Service, flies tremendous loads out of some of the wildest country in the world.

Guiseppe M. Bellanca

Q. With what kind of motors will these super-airliners of tomorrow be powered?

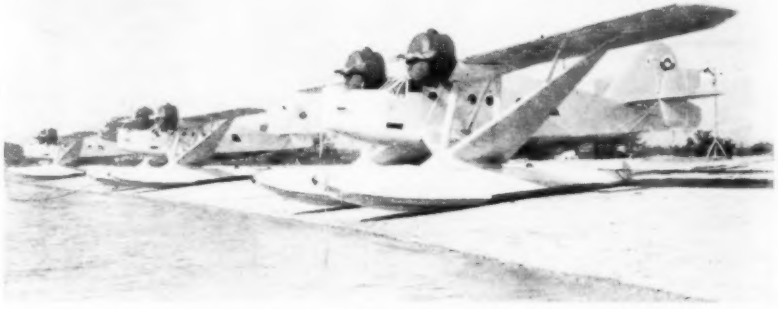
A. "I believe that the internal combustion or explosive type motor will still be in general use even in 1960. Of course, it will have undergone many refinements. It will be much larger and much lighter in proportion to its rated horsepower than those of today. The one radical change in power-plants will be made in their location in the ship.

"Today's motors are located on the outside of the plane, either on the nose or the leading edge of the wing. In tomorrow's multi-motored transports the motors will be housed in engine rooms completely inside of the wing, making it possible for mechanics to service and overhaul a motor while the other power-plants hurtle the plane forward on its scheduled flight. Today's ocean liners use the same motor-service system. The main idea is to keep the ships moving.

"Cooling will be effected by means of an arrangement of air tunnels scooping the air in from the front, circulating it around the motor, and exhausting it out the rear.

"Whether future power plants will be of the diesel type instead of gasoline, I don't know. I am looking forward to refinements in the diesel motor, for this type of power will be more economical and will almost entirely eliminate the dreaded fire hazard.

"On the other hand, gasoline has been refined and stepped up to the maximum one hundred octane content. This special new fuel has been produced at great expense in very limited quantities. When engineers finally produce it in abundance and design motors which can fully utilize it, a great increase in speed and power will result."



Twin-engined Bellanca seaplane bombers recently designed and built for the Colombian government. These ships will carry a heavy load at high speed for hundreds of miles non-stop.

Q. Do you believe that wireless electric

This Bellanca, a Pacemaker freighter, also is doing heavy work in remote corners of northern Canada. On the 420 horsepower Wright engine this ship carries a one ton pay load.

power will be broadcast from power stations and made to run electric motor planes by 1960?

A. Scientists talk of broadcasting electric power from the ground to planes in the air. While this may be possible, I do not look for its practical use until several decades have passed."

Q. What does the future hold for the folding-wing 'giro-plane?

A. "I can visualize a 'fixed-rotor plane'. By that I mean a plane that will ascend vertically by means of a single, controllable-pitch 'giro-blade, a blade which could, at the will of the pilot, be stopped in a fixed position and act as a supporting wing for high speed flights after a cruising altitude has been reached. It is possible for such a plane to be so arranged that it could descend vertically for a landing and hover motionless over the desired spot just before coming to earth.

"A plane with such flexibility of control would be invaluable when air traffic of the future becomes congested. Landings could be made on roofs of buildings as a matter of course."

Q. How do you think the complicated air traffic problem of tomorrow will be solved?

A. "That is something I do not worry about. There are those who view the future aerial traffic problem with alarm, but their fears are unfounded. The situation will automatically take care of itself. Instruments will be improved to a much greater degree of accuracy than that of today, for one thing.

"The roads of the earth comprise far, far less than one tenth of the earth's total area. When we take into consideration the innumerable layers of altitude over the globe's surface we find that this vast air strata will accommodate far more planes than mankind will ever produce.

"I believe that when air traffic actually becomes a problem the government will establish certain set radio beam courses linking all cities and towns in the United States and will require all aircraft to fly on them at certain specific altitudes, the height to be determined by the size, speed, and type of ship and by the weather conditions. These altitudes would be standardized by the government.

"Such a system of air traffic regulation will come about of its own accord just as our system of auto traffic regulation came into being, so I don't worry about it at all."

Q. Will most of the future flying be done in the stratosphere?

A. "For long flights the stratosphere will be the medium through which future speed planes will travel, but for shorter hops the atmosphere will be used."

Q. What does the future hold for the freight and passenger carrying stratosphere rocket-ship?

A. "With all the existing knowledge

(*Continued on page 52*)

A thousand miles non-stop is the cruising range of this six-place Bellanca Pacemaker Executive model. It is powered with a 420 horsepower Wright Whirlwind engine.

Taylor Cub No. 1000

THE Taylor Aircraft Company announced last week that it had delivered the 1000th airplane following the All American Air Maneuvers at Miami, Florida.

This is the largest number of non-military airplanes ever manufactured by any one company, and the plane was delivered to Mr. James Erdmann of the Blevins Aircraft Corporation at Atlanta, Georgia.

According to figures recently compiled by the Aeronautical Chamber of Commerce, a total of 664 aircraft for civilian use was manufactured during the first six months of this year. Of this total of United States non-military aircraft, the Taylor Aircraft Company accounted for 28.91 per cent of the production.

In the United States there are 15,763 licensed pilots and 29,652 licensed student pilots; a total of 45,415 a number which far exceeds the total licensed planes, 9,621 in all. The Taylor Company feels that this indicates the immediate demand for a universal plan, to which may be added the 1,000 persons who, in a recent survey, signified their intentions of purchasing a plane within the next two years.

Altogether there are 76 airplane manufacturers and 26 engine manufacturers, most of whom are employed on government or airline production. This brings the average licensed plane production slightly over 100 planes per manufacturer or an average production of 21 planes per year per manufacturer.

The Bureau of Aeronautics, in 1933, gave aviation a fresh start and worked on a basis that a new airplane could be produced for $700.00. The bureau has done a wide variety of experimenting on planes with three wheel landing-gears, planes without tail surfaces, planes using modified automobile engines in an attempt to stimulate modified consumption.

The airplane industry continued along two courses; one group sticking in the $5,000 field in which last year the Waco Aircraft sold 103 planes, Fairchild, 95, Stinson, 69. In the other class field, the Aeronca led the small producers with a production of 52 planes in 1933.

Then the Taylor Aircraft Company brought out a plane looking exactly like a clean cut airplane of the larger class on a small scale. In 1934 it sold 76 planes. Last year it sold 211, and this year it placed an order for 1,050 aircraft motors made by the Continental Motors Company.

Will It Come to This?

"HENRY, your left wing tip is a little low." "Henry, are you sure we've got enough gas?" "Henry, why does that woman always come out and wave when we fly over?" "Henry, don't fly across those railroad yards, we're sure to get an awful bump." "Henry, I'm sure this compass is way off." "Henry, isn't that an airport near that little town over there? I think I'll have to stop and . . ."

Seen At the Paris Aero Show

by R. C. WOOD

While the United States toys with military aircraft to a comparatively small degree, Europe and Asia have devoted all their aeronautical genius to new invention. Here are some surprising revelations.

A NEW commercial plane that proved an attraction at the Paris Show was the Russian long distance range low cantilever wing monoplane, type ANT 25, having a wing span of 110 feet and aspect ratio of 13.00.

It is constructed of duralumin and powered with a 1,000 h.p. liquid-cooled Russian engine in "V" arrangement, equipped with a three-blade propeller. The controls and undercarriage are operated electrically. The wing spread is 110 feet with a wing surface of 950 square feet; the weight loaded 24,750 pounds and it has a flight radius of 7,500 miles at a maximum speed of 162 miles per hour.

In September, 1934, Russian pilots covered 12,411 kms (7,750 miles) with this plane flying over a closed circuit.

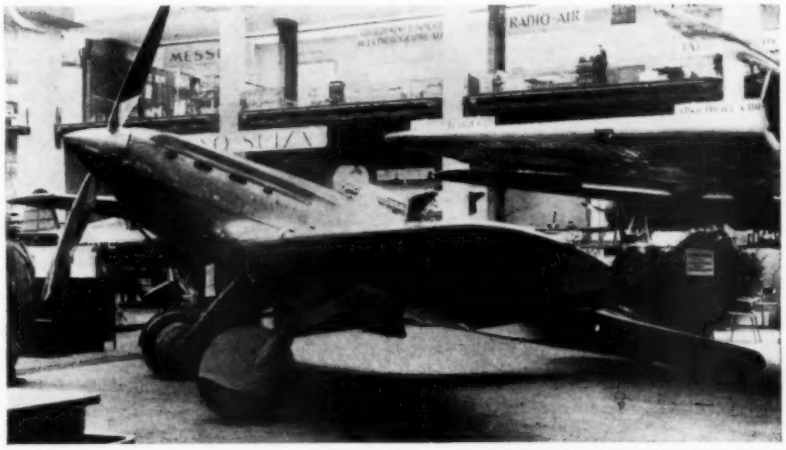
The fast single-seater French pursuit ships exhibited at the Show such as the Morane 405, Dewoitine 510, Loire-Nieuport 250, etc., were low cantilever wing monoplanes equipped with split flaps and retractable undercarriages. The speed attained has increased from 240 m.p.h. to about 300 m.p.h. since 1934. They are powered with engines of 850 to 1,000 h.p. and have an average weight of 2,000 kgs (4,400 lbs.).

The Dutch constructor, Frederick Koolhoven, also presented a single-seater pursuit ship of original design for which he claimed a maximum speed of 325 m.p.h. A Lorraine "Petrel" liquid-cooled engine, 12 cylinders in "V" form, is mounted inside the fuselage behind and underneath the pilot, approximately on the center of gravity of the machine, which renders the plane exceptionally maneuverable. Cooling "gills" are provided in the sides of the fuselage.

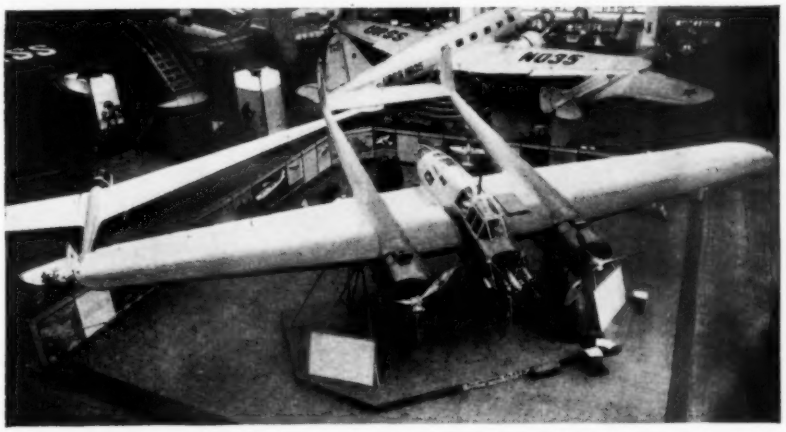
The engine is fitted with two propellers turning in opposite directions, driven through a shaft and gear-box. This mounting does away, it is claimed, with the adverse effect of the propeller torque and the distortion of the air currents on the wings, thus making the plane light and easy to fly. A low aspect ratio can also thus be attained with considerable torsional stiffness and the risk of flutter at high speeds or sudden changes of altitude eliminated.

The pilot is seated in front of the wing and has an entirely unobstructed view in all directions except straight downwards. The cockpit is covered by a hinged transparent roof which can be easily released in case of emergency. It is equipped with a retractable undercarriage.

The general characteristics are as follows: Span, 28'-6"; length, 27'-0"; height, 8'-6"; wing surface, 166 square feet; weight, empty, 2,645 pounds; fixed load, 154 pounds; crew (1 with parachute), 198 pounds; oil, 66 pounds; fuel, armament

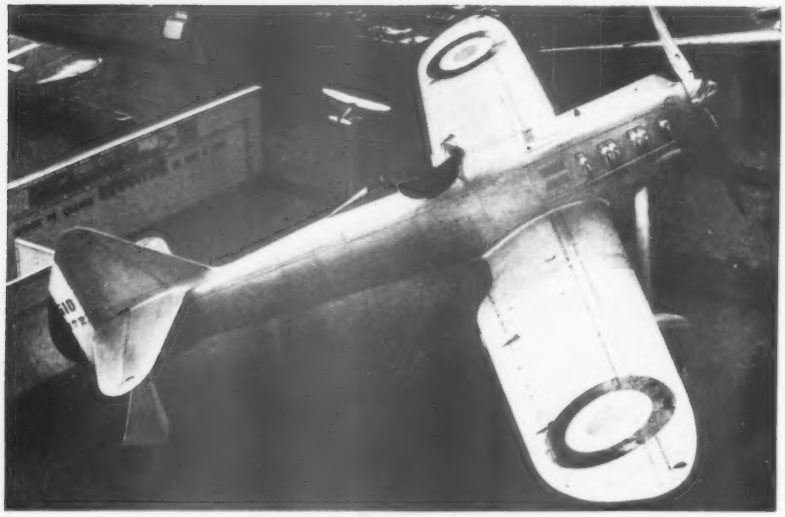


A new Russian fighter, replete to retractable landing gear and a particularly brutish-looking business end—the Avion 2KB-19.



Tony Fokker is definitely in aviation yet. This light attack ship is more than ample proof of that. Note the machine guns in the nose and the American-made controllable-pitch propellers.

The Dutch may be a quiet race but they're not asleep when it comes to military aviation. Here is a new mystery fighter built by Koolhoven. Note the two separate propellers.



A glimpse of the Dewoitine Model 570 pursuit plane at the show.

and ammunition, 902 pounds; total weight, 3,968 pounds; maximum speed at 4,400 meters (14,300 ft.), 520 kmhr. (325 m.p.h.); cruising speed at 4,400 meters, 450 kmhr. (285 m.p.h.). Landing speed 105 kmhr. (65 m.p.h.).

The pursuit planes now have serious competition in the new type, twin-engined two or three-seater attack planes, which are also especially adapted for reconnaissance and bombing work.

These new latest machines are as fast as the new pursuit ships of today often attaining speeds of about 500 kmhr. (312 m.p.h.) and they also possess the advantage of being able to transport a greater useful load and thus permit better armament and execution of various missions at high speed.

Among the planes of this class exhibited at the last month Show, were the Potez 63, equipped with 670 h.p. Hispano-Suiza radial air cooled engines, the Hanriot 220, mounted with 2 Renault 450 h.p. inverted in "Vee" form air-cooled engines and the Fokker G 1, powered with Hispano-Suiza radial air-cooled engines rated at 750 h.p. at an altitude of 3,500 meters (11,500 ft.), and fitted with three bladed Hispano-Suiza Hamilton Standard controllable pitch propellers.

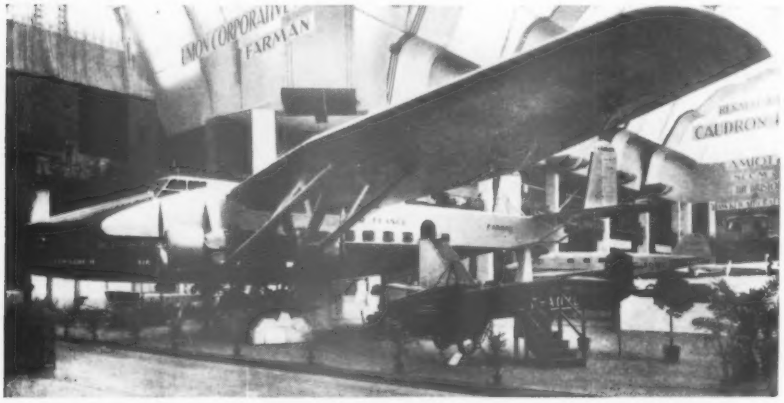
Of these planes, the Fokker has a distinctively original design. It is a low mid-fuselage, cantilever wing, two-seater monoplane with a maximum speed of 292 m.p.hr. and a flight radius of approximately 870 miles, which fits it to be a strategic reconnaissance machine and owing to its high speed and excellent climbing power it is also suitable for an attack and bombing plane.

The wings are attached to the middle of the fuselage and thus form one unit. The engines are mounted on the leading edge of the wings, which are of one thickness between the engine beds but the outer sections taper toward the tips.

The tail plane is secured by two outriggers attached, one on each side of the fuselage, to the wings and continue straight aft behind the engines. The extremities of these booms are connected by the tail plane which carries an elevator extending over its entire span.

The heavy bombing planes exhibited were machines with their lines consider-

(*Concluded on page 70*)



And here's the large Farman 40 passenger transport plane at the show.

Here and There
by M. A. RODDY

ACCOMPANIED by Bennett Griffin of trans-Atlantic fame, Eugene Vidal, director of Air Commerce, landed in Chicago flying from Detroit in the "Air Navigation Laboratory" of the Department of Commerce.

During the flight Director Vidal conducted tests of a Bendix radio-compass which will enable pilots to contact regular commercial radio broadcasting stations for the purpose of orientation.

Known as the Lockheed 12A the flying laboratory was designed on basis of Department of Commerce specifications and will be used by Bureau airline inspectors in examining airline pilots and checking airlines as well as for development of airline equipment and aids to airline navigation and blind-approach testing.

The 12A is a low-wing all-metal monoplane with a wing span of 49½ feet powered with two Pratt and Whitney Wasp Junior engines of 450 horsepower each.

Cruising speed is 213 miles per hour; cruising range, 1,000 miles with pilot, co-pilot, and four passengers, or pilot and five passengers, or it may be operated as an 8-place craft with 2 pilots and 6 passengers with a loss in cruising range.

Special safety equipment features the craft including complete two-way radio; a radio-compass; de-icing "overshoes" on the leading edges of the wings and stabilizers; propeller de-icers; constant speed propellers; automatic pilot and radio antennas so mounted as to keep them free of ice.

While the ship was being serviced at Municipal Airport Director Vidal stated, "The excellent record of progress for the past year in aviation is most gratifying because the growth has been sound.

"Scheduled air lines have transported more than a million passengers exceeding all previous records with air mail and air express headed for new highs in poundage.

"Some manufacturers," Mr. Vidal continued, "have found it necessary to step up production so rapidly that there actually has been a shortage of trained workers, particularly trained metal workers."

Flying by private owners and miscellaneous operators, which includes charter and taxi flying, aerial surveying, crop dusting, experimental flying and student instruction, is expected to total about 90,000,000 miles in 1936, a substantial increase over 1935.

* * *

Although denied by Mr. Vidal reports persist that he will resign his office shortly with a view of entering private industry.

However, at present the air commerce Director is concentrating upon a safety program to be adopted for the improvement of airline service.

Plans call for the expenditure of 10 million dollars during the next two years for the installation of new safety devices and radio facilities to be added to those already on the federal airways.

(*Concluded on page 64*)

Edward—King or Duke—Is a Flyer

by BERT D. LYNN

Immediately after assuming the throne, Edward flew from his palace to London. Not only was he the first king of England ever to fly; he was first to leave his throne by airplane.

WHEN David Windsor in the winter of 1935 became King Edward VIII of England, only to quit his throne last December for love of a commoner, he not only made political history but aviation history at the start and at the end of his brief reign.

On the first day of his rule the young monarch flew in his own plane from the palace at Sandringham to London, thereby becoming the first British sovereign to fly. And as he came, so he left. Giving up his crown for love of the American, Mrs. Wallis Warfield Simpson, Edward became the Duke of Windsor, whereupon he climbed into the cockpit of a plane and flew to the dock of a destroyer waiting to carry him across the channel.

Thus did Duke Edward, in every way a precedent-smasher and the subject of one of the century's biggest news stories, become the first British king to fly and also the first ex-king ever to flee his throne by air.

Because of the intense public interest in the life of the former king and so that POPULAR AVIATION readers may have a record of his aviation activities as well as excellent photographs of his personal planes, this article is presented.

For years, in his own phrase, Edward has looked upon flying as his main means of transport. He has flown extensively in the British Isles and overseas and has owned more private aircraft than any other Englishman. The example he has set has done much to help civil aviation through its early difficult years.

Even as king, he was no fair-weather flyer and expresses keenest annoyance when mention is made of the "risks" he runs in the air. To such questions Edward is wont to mention the high safety standard of the modern airplane plus his own long experience on which he founds his decisions whether or not he will go by air in difficult weather. Himself competent at the controls, although he has not officially qualified for a license, the ex-king brings a calm judgment and skill gained in hundreds of flying hours to reinforce the opinions of his pilot.

David Windsor or Duke Edward bought this DeHavilland Dragon in 1933. It was just one of the many airplanes the young monarch and royalist owned. This particular ship is powered with two 130 h.p. engines.

Up to the present, Edward has included at various times ten planes in his private air fleet. Before 1929 he flew almost invariably in an ordinary Royal Air Force military craft. But in the summer of that year he acquired for his personal use a Gipsy-Moth open-cockpit light biplane.

In 1930 this modest craft was supplemented by two Puss Moth light cabin monoplanes, which a year later were replaced by two later models of the same type.

In November, 1932, Edward bought a cabin biplane having additional cabin and luggage space. This was to be the last small single-engined plane in his fleet. In the spring of 1933 he acquired a Dragon biplane and a large Vickers-Viastra monoplane, each two-engined. The Dragon carried six passengers and the Viastra twelve.

In 1935 these two machines were turned over to the Air Ministry to be used for special radio research. In their place were purchased the two Dragon-Rapide biplanes which today are the Duke of Windsor's flying limousines and at least one of which, it is reported, will soon follow the former king from England.

Like all the earlier planes the Dragon-Rapides are colored in the scarlet and blue of the Brigade of Guards. The wings are silver. They carry the British registration marks G-ACTT and G-ADDD. Each plane is fited for the luxurious accommodation of six passengers in comfortable armchairs.

The specially-designed cabin furnishings include a writing table and a cocktail cabinet. Two electric heaters are so arranged that they can be used as foot-warmers. Provision is made for serving meals on board and the equipment includes Edward's own electric tea kettle.

Aft of the lavatory is the rear luggage compartment containing a complete refrigerating plant with a capacity of about 1½ cubic feet, and stowage for a typewriter and a gramophone and records.

The roomy cabin is paneled in five different veneered woods, all of which are grown in the British Empire. The upholstery in the interior is grey and red. Insulation of chamois leather and fireproof airtight paper plus the double-thick non-shatterable windows make a cabin which is quieter than a compartment on an express train. Smoking in the cabin is permitted.

The planes have a top speed of 160 miles per hour. They carry sufficient gas for non-stop trips anywhere within the British Isles. Navigational equipment includes a powerful two-way radio set and complete instruments for blind flying. Ceiling compartments contain parachutes for all passengers.

(*Concluded on page 70*)

His first airplane. Edward bought this Gipsy Moth in 1929 and spent many pleasant hours at the controls while those who watched after his well-being fretted at his "chance-taking" on the ground.

A Glimpse at the New Howard DGA-8
(See front cover drawing)

A side view of the Howard DGA-8 reveals a well laid out cabin with maximum visibility.

BENNY HOWARD has very recently introduced his Howard DGA-8 cabin job, intended primarily for the private owner and business executive.

It is provided with an unusually large and comfortable passenger compartment, with plenty of leg-room in which adjustable seats insure comfort for all. The front seats are adjustable, fore-and-aft and also vertically and are spring balanced so that adjustment can be made quickly and easily. The rear seats are of the hammock type and even with the front seats moved back to their farthest limit, there is still ample leg-room for those in the rear seats.

Due attention has been paid to the baggage problem, hence the exceptionally large baggage space to the rear and an additional space behind and above the rear seats for such small articles as hats, gloves, etc. The soundproofing applied to the cabin has reduced it to the noise level approximating that of an automobile. The large rear baggage space is accessible through a large outside door which is a great convenience.

The gasoline supply is carried beneath the floor in two tanks with a total capacity of 90 gallons, the supply of gas to the engine being through an engine driven fuel pump and an auxiliary wobble pump. A simple valve arrangement within easy reach of the pilot selects either tank for drainage, an obvious safety feature in a crash.

By locating the tanks below the floor, several distinct advantages are gained: (1) This is an obvious safety factor in a crash; a positive fuel supply is assured without the danger of gas-locks so common with gravity feed; it does away with the necessity of climbing over the plane when servicing, avoids spilling gas and permits the attendant to stand with both feet on the ground while observing the gas flowing into the tank openings. And the tanks are so arranged that they can be completely removed within a very few minutes without disturbing the finish.

The power-plant consists of a Wright Whirlwind R760-E2 engine rated at 320 horsepower which drives a Hamilton Standard Controllable pitch propeller. Accessibility to the engine group, including oil-tanks, radiator and battery can easily be accomplished by the removal of the entire cowling and ample room has been left between the engine and firewall for working on the accessories.

An all welded chrome moly steel tube construction is employed for the fuselage, covered with fabric. The wings are carried by two solid spruce spars with truss type spruce ribs and are braced by the conventional external vee braces. The wings are completely covered with plywood which is, itself, covered with fabric for finish and

(*Concluded on page* 68)

A three-quarter front view of the Howard DGA-8 which has met with the approval of many men versed in airplane design.

Aviation Aids Science

TWO unusual aerial surveyors have been launched in eastern United States.

One is to obtain information on the habits of air-borne pollen, nemesis of hay fever victims, and is being undertaken by the Philadelphia College of Pharmacy and Science. The metropolitan area of Philadelphia and a section of southern New Jersey centered about Atlantic City and extending seaward 20 miles are the sites of the study.

"Washing" of the air at stated altitudes is made possible through use of new apparatus. The major element is a tube, flared at the collecting end like a cornet. This is attached to the wing of the airplane and is connected by means of a rubber coupling to a wash-bottle which is fastened in the forward cockpit.

In an effort to expand knowledge of the extent and range of nature's annual fireworks in New England, a scientific airplane survey of Fall foliage was conducted over six states. The brilliance of this foliage is so famous that many Europeans come to this country each fall to enjoy the gorgeous spectacle.

Science has not yet discovered what factors govern the time when the leaves turn color, the location of the most brilliant hues and what temperatures produce the most intense coloration. These facts the airplane observers attempted to discover.

Gas Bag Observations

AT the annual dinner of the Veteran Balloon Officers of the World War, Col. John H. Jouett, former commanding officer of the balloon corps in France, said captive balloons were still the only dependable method of directing artillery fire.

"I have talked this over with the Signal Corps very recently," he said, "and I am informed that there is yet no method of radio communication between aircraft and ground which cannot be 'jammed' by the enemy.

"Balloonists, on their elevated platforms as observers, with telephone lines to the batteries, still form the only sure means of communication. With balloons further armed with non-inflammable gas, the function becomes still more dependable and important."

A Source of European Photos

COLLECTORS of Airplane photographs will be interested to learn that they can obtain real photographs of British, American and foreign airplanes from Real Photographs Company, Cooper's Buildings, Church Street, Liverpool.1, England.

This firm publishes a List which will be sent post free on application to any reader of POPULAR AVIATION mentioning this magazine. Their Lists contain over 400 titles. All photographs are in the form of postcards and retail at 63c per dozen.

Santa Now Uses An Airplane

by MAX KARANT

ICY salt water broke white over the jagged rocks of Mt. Desert Rock light. The day was clear and cold. Several hundred idly circling sea gulls settled slowly to the cold, barren rocks. The Atlantic churned angrily as the age-old boulders smashed the driving waves into harmless clouds of salt spray. The gulls gave no thought to the hard beauty of nature; they roamed the tiny island in search of scraps of food.

Up in the sturdy lighthouse tower the rough-clad keeper patiently labored over his precious charge—The Light. Suddenly the gulls that had settled on that lonely bit of rock more than 20 miles off the coast of desolate northern Maine, screeched madly and flapped away in fright. The keeper looked to see what had alarmed the birds. There, just a few feet off the ocean to the southwest, flew an airplane.

That was all that keeper needed. He dashed to the tiny circular steel ladder and headed for the ground, four steps at a time. He banged out of the tower door and into the tiny stone house in which he and his family live through the long winter months. A few seconds and the rock's entire population was in the open, waving frantically.

"It's Bill Wincapaw!"

Just skimming the ocean's surface at 100 miles an hour, the big tri-motored monoplane was rapidly nearing the island. As the Stinson airliner drew within a few yards of the tiny island's shore, the pilot throttled down the three thrumming engines to idling speed. The big ship "slowed down" to about 80 miles an hour and soared directly over the lighthouse. The madly clamorous little group saw the pilot wave one arm.

Then, as the big plane passed directly over the little stone house, a heavily wrapped rectangular package plummeted down and bounced heavily, almost at the feet of the keeper and his family. There was a mad scramble for the precious bundle. The plane circled steeply back over the island as its "bomber" waved happily from his special hatch in the cabin door to the little lonely group below.

This lonely enble station off the coast of northern Maine had just received its annual aerial Christmas present when this picture was snapped out of the special hatch. That's the plane's tail covering the station roof.

Bill Wincapaw, Jr., about to "bomb" an island far out in the Atlantic.

Lighthouse keepers live on mere rocks like this many months at a time. A large part of the time it's impossible to get to outposts like this because of heavy seas. These people look forward eagerly to Bill Wincapaw's annual visit.

The average person, when introduced to Capt. William H. "Bill" Wincapaw, probably would refuse to believe that that clear-eyed little man earns his living in the manner he actually does. Though Bill Wincapaw really doesn't look his 51 years, he never would be taken for an airman of any kind, let alone one of the nation's pioneer aeronautical veterans. If there's anyone in the Wincapaw family that looks at all like the popular conception of an aviator, it's Bill Wincapaw, Jr., already a flying veteran at 19.

It was Bill, Sr., who was flying that big airliner which the lighthouse keeper and his family greeted so energetically and it was Bill, Jr., who "bombed" the island on this last Christmas Day.

The keeper of the light on Mt. Desert Rock isn't the only one of these lonely watchmen of the sea who knows Bill Wincapaw. Not by far. Bill was born in Friendship, Maine, in 1885, and we'll presently see why Friendship is proud that that particular birth took place within her village limits.

Bill Wincapaw was born in a rough two-fisted country in rough two-fisted days. He was raised among one of the hardiest groups of men in America's heritage—seamen. From these sturdy folk, who literally take their danger as they do their meals—three times daily (and then some)—Bill Wincapaw developed an enviable supply of that fairly uncommon quality after which his birthplace was named. Bill's admiration and respect for the lighthousemen, coast guardsmen and north Atlantic fishermen is what earned him his fame.

Bill first took to aviation in 1911 when he learned to fly under the tutelage of Glenn Curtiss. In those days, once a pilot soloed he automatically became an experienced aerial veteran, so Bill Wincapaw went right into business. It can be taken for granted, of course, that he went into

commercial aviation in his most-loved section of the United States—along the Atlantic coast from Massachusetts to New Brunswick.

Rockland, Maine, was the site of the first Wincapaw aerial business establishment. There Bill successfully operated his own company and had charge of the Curtiss marine base there. This sort of flying helped Bill earn an enviable record as one of the Atlantic coast's best "boat" pilots. Many of the north Atlantic mariners also owe their lives today to the fact that Bill's love for these people sent him flying out into the ocean into the teeth of treacherous storms to bring a badly injured man, woman or child back to medical aid. . . .

To most people in the United States, Christmas means a happy snowy holiday around the traditional balsam with presents to surprise and gladden young and old alike. But, to the comparatively small group of hardy folk whose task it is to guard the treacherous rocky north Atlantic coastline, Christmas usually marks the beginning of the dreaded season of freezing cold, pounding storms and battering mountainous seas—everything that spells death to the mariner who happens to be blown too close to that dreaded shore. To the patient, fearless guardians of this dangerous coast, then, Christmas only means a beginning to wintry hardship.

Each of Bill Wincapaw's Christmas flights has been longer and tougher than its predecessor. From a small plane-load in 1928 when he made his first "Santa Claus" flight up the coast, the 1936 flight took two days to make with a big tri-motored Stinson loaded almost to capacity with scores of bundles.

From just a few newspapers and cigarettes back in the early days of Bill's gift-dropping, a typical 1936 bundle weighed 16 pounds and usually contained coffee, cigarettes, almanacs, doughnuts, cookies, toys, women's hose (for lighthouses where the keepers are allowed to have their families), chewing gum and candy—things that might appear a little silly to the average landlubber who needs only to stroll to the corner drug store for many of them.

Wood Island as seen through the cockpit window. "Santa" Wincapaw is at the controls. Note how low the plane is flying by the ripples on the ocean.

Miss La Touraine roars low over a rocky island. The cone in the center of the picture is the right engine's nacelle. Note the lighthouse keeper and his family above and to the left of the lighthouse's base.

But to those lonely people these little things dropping from the sky are a luxury none would trade for 16 pounds of gold. The average value of each of the 125 bundles dropped by Wincapaw on his 1936 flight was $7. This year's flight cost roughly about $5,000, was paid for by Boston and New York business men.

Through George Mason, an associate of Wincapaw's, I was invited to make the entire 1936 flight up the Atlantic coast as an "assistant Santa" and as a representative of POPULAR AVIATION. An American Airliner landed me at Boston airport, southern terminal of the Christmas flight, the night before the first section of the exhaustive flight was to be made. The next morning at dawn (Dec. 24) the plane took off carrying a comparatively small number of packages and several newspapermen.

A special hatch had been cut in the cabin door of "Miss La Touraine," the 1936 aerial reindeer-and-sleigh. A camera plane that followed us up from Boston airport flew close to our right as cameramen shot Bill, Jr. several times as he "bombed" Graves light, the Nahant coast guard station and Marblehead light. The camera plane turned back to Boston at Marblehead.

That morning — Thursday — I received my initiation into the Ancient Order of Hedge-Hoppers (or I should say Wave-Hoppers). Being a native of the middle-west where 500 feet off the ground is hedge-hopping to a fine degree, it took several hours of 10-feet-off-the-ocean flying to get me used to it. And before I boarded a United Airliner at Newark airport Christmas night after the final flight, I had done more low flying than many inland airmen would dare in a lifetime.

Practically all of the two-day flight was made just off the surface of the ocean. At 100 miles an hour we skimmed farther and farther north, "Bombing" lighthouses, coast guard stations and isolated fishing huts as we went . . . Baker's Island, Eastern Point, Thacher Island, Straitsmouth Island, Merrimack Reef, the Isle of Shoals . . . one after another Bill would throttle back and "Miss La Touraine" would settle into a slow glide and at the right instant Bill, Jr., would heave the package overboard to the waving group below.

Thursday's flight covered our "stops" as far north as Old Orchard Beach, Maine. Then we headed back for Boston where National Broadcasting Company engineers waited to install broadcasting equipment for a program from the air that afternoon.

It was still dark the next morning when we stacked bundles in all corners of the big tri-motored ship. Only four of us would be aboard this trip, for it was the main flight and was scheduled to cover everything as far north as New Brunswick and the Bay of Fundy. Bill Barnes, Boston newspaperman, and I helped the two Wincapaws load the plane.

In a few minutes we were climbing slowly away from Boston airport into the lightening sky over the Atlantic. Roaring up the endless New Hampshire beach in the early morning light, our first goal soon showed dark off to our right as the rising sun set it off against the sparkling ocean. A slight touch on the control wheel and we headed out to sea with "Miss La-Touraine's" nose engine on Boon Island, a few miles off Cape Neddick. Boon Island's handful of humans awaited us despite the early hour.

Bill throttled down the engines as Bill, Jr., aimed at the tiny bit of rock and its lone lighthouse. "Let 'er go!" boomed back from the controls and young Wincapaw threw the package. A steep bank toward the mainland in the distance and we could see the islanders happily tearing open their "stocking."

As the sun rose higher in the sky, Cape Porpoise, Wood Island, Trundy's Reef, Ram Island and Jordan's Reef passed under our wings. Then we banked inland and landed at Portland, Maine, for fuel. No time was wasted there and we were in the air again in a few moments. Back to the breath-taking ocean-skimming and Halfway Rock, Seguin Island, Damariscove Island coast guard station and far-out Monhegan Island were checked off on the map. We headed back to sea after zooming the White Head Island coast guard station and, after circling Matinicus Rock almost a dozen miles off-shore, again turned toward the northwest and Vinal Haven in Penobscot Bay.

So it went with methodical, matter-of-fact precision. We visited each little station and island on the detailed marine map. Each time Bill Wincapaw's grateful friends would wave Christmas greetings at our low-flying airplane.

On up the coast to Bass Harbor Head and Great Duck Island, then to sea again to visit the farthest-out point on the entire flight—Mount Desert Rock, 24 miles off-shore.

Instead of a dangerous, hair-raising dash up into the wilds of Maine and New Brunswick, our adventure was confined to the killing of a chicken on one island as Bill, Jr., aimed at the island's tiny flock and scored a bull's-eye. Then there was the

(*Continued on page 56*)

A Few More All-Wing Planes

by LEWIS OWEN

In addition to the group of all-wing planes described by Mr. Owen in the September issue of POPULAR AVIATION, the author rounds up the remaining all-wings in the following article. He was assisted by Raoul J. Hoffman, designer of the Arup.

IN the September, 1936, issue of POPULAR AVIATION I reviewed a number of interesting flying wings types, and now will conclude the series with a description of such well known all-wings as the Pterodactyl, Fauvel, Stout, Kohl, Lesh and Arup designs.

Since the publication of the first article the French Government after extended tests have issued reports stating that the flying-wing type is not a feasible type and is therefore under the ban of the government. This, however, should not discourage experimenters, for government officials have made misleading and inaccurate reports before.

We now come to a unique development of the Flying Wing. This plane, shown in Fig. 1, is the Westland-Hill "Pterodactyl M.K.V.," and is the only military type of Wing constructed since the "Dunne."

Like the "Dunne," it is a biplane, but in this instance the lower wing, which has no sweepback, acts mostly as a brace to give the strength necessary for a combat type. This brings to mind the World War "Nieuport," which was in reality a parasol monoplane with a lower wing which was simply a streamlined girder, added to provide proper bracing.

The present "Pterodactyl," which is the latest of a series of similar ships, has surprising speed and maneuverability, and shows evidence of becoming a practical military type. Although the extreme stability of the "Dunne" has been sacrificed in favor of this stunting ability, the plane is still proof against the stalls and spins to which more conventional designs are addicted.

The ship is absolutely devoid of the fatal "blind spots," the observer-gunner, who faces to the rear, having a very wide arc of fire, and no tail group or aft fuselage to shoot off.

The latest and one of the most successful of the sweptback Flying Wing is the already famous "Arrow," designed by Waldo Waterman for possible production in the much discussed $700 class. The details of this little pusher monoplane are too well known to be repeated here.

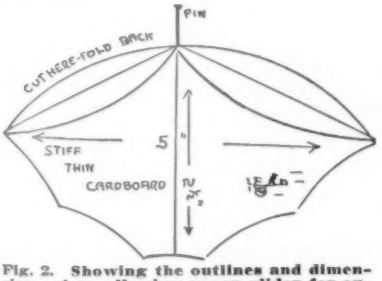


Fig. 2. Showing the outlines and dimensions of an all-wing paper glider for experimental work.

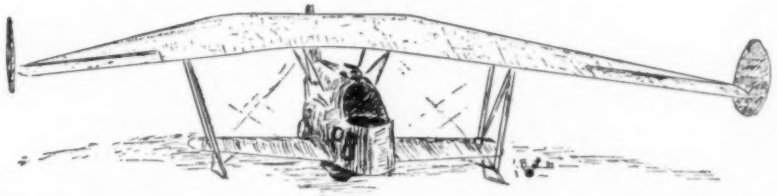


Fig. 1. Westland-Hill "Pterodactyl," an all-wing plane that has passed through many experimental stages.

Fig. 4. The Kohl Flying Wing.

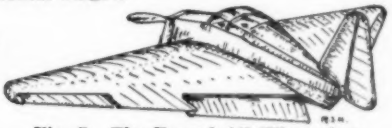


Fig. 5. The Fauvel All-Wing plane.

It is enough to say that it is what may well turn out to be the answer to the aviator's prayer, a sturdy, safe and reliable plane whose low production and maintenance cost bring it within the reach of our slim bankrolls.

The first of Waterman's designs to attract any attention was the "What-It," likewise a tailless monoplane. This plane was successful enough to be shown in the newsreels, where it generally caused a bit of laughter. The "Arrow" was its direct descendant and was sponsored by the Department of Commerce in its search for a practical "flivver" plane.

That concludes the list of Flying Wings which employed sweepback. The other division of the high aspect ratio group, that having taper alone, is almost equally popular, although more recently so.

The first "modern" instance of the application of taper to a Flying Wing is in the 1929 "Unu," designed and constructed by A. Kupper of Germany. This machine was a glider, consisting of a stubby fuselage and long, cantilever wings with twin rudders at the tips. Little can be learned of the construction and performance details of this ship, so it was probably only a qualified success.

In the same year M. Fauvel of France obtained a patent on his design for a Wing, as shown in Fig. 3, which was drawn from the patents records. The design covered a machine with a cantilever wing tapered both ways. An overhead motor mounted on struts à la seaplane is called for. The patent drawing also shows several unique features which seem almost amateurish. These include the method of directional control, and the method of counteracting torque.

In lieu of rudders, M. Fauvel proposed to use sliding panels at his wing tips. Upon exposing one of the panels, the air resistance would slow up that tip, and the plane would turn. These panels could also be used as air brakes by extending them both simultaneously.

For counteracting torque, he devised an arrangement whereby the motor when turning over moved slightly forward on its hinged mount. To the mount was attached a wire which, by means of pulleys, raised one end of a lifting strut, supported by two fins at the trailing edge of the wing.

The faster the motor ran, the more the strut tilted, and the plane remained level. Just what would be the effect of having a motor that roamed all over the plane can easily be seen. However, the basic design was good, and sometime later a plane was constructed under these patents which was quite successful.

Late in the year 1931 Germany again appeared on the scene with a very well designed machine. It was called the "Köhl Flying Wing," after Captain Hermann Köhl, famous trans-Atlantic flyer who sponsored its construction. The plane was designed and constructed by the aforementioned Alexander Lippisch and the celebrated German glider pilot Günther Groenhoff.

As can be seen in Fig. 4, sketched by Mr.

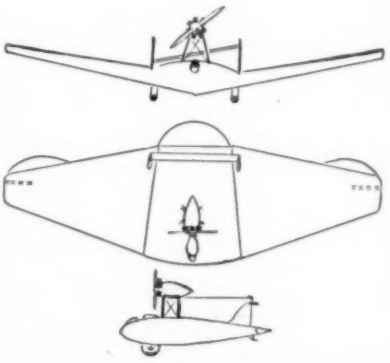


Fig. 3. These views were taken from Fauvel's patent drawings and show the salient features of the Fauvel design.

XUM

Hoffman, the plane was a pusher type with twin rudders at the tips of a wing whose leading edge was swept back to a considerable degree. The two cylinder motor which developed 30 h.p. drove the little ship at a top speed of 90 m.p.h.

The design of this craft differed from that of other Wings by eliminating the negative wing tips. Just how this feature was replaced is not known but the plane performed exceptionally well, being very easy to handle. Dead stick landings were accomplished without any difficulty.

The reasons which Herr Lippisch may have had for abandoning the sweepback and negative trailing edges which he employed with such success on his "Storch" planes, were not made public, so it may be assumed that in reality he had little to do with the designing of the "Köhl Wing."

In 1932 France came through with the most beautifully streamlined of all the Flying Wings which had thus far been constructed. The "Guerchais Wing," designed and built by Louis Guerchais under the Fauvel patents, boasted fully retractable landing gear, and a cabin which faired smoothly into the deep wing. The motor, a 20 h.p. Goiot, was mounted on four struts above the cabin. All the objectionable features of the Fauvel patents were discarded, leaving a very praiseworthy ship.

The wing span of this machine was 33 ft. with an area of 215 sq. ft. Her total length was 11½ ft. including the rudimentary tail, and she stood 6 ft. 3 in. high, exclusive of the motor.

In contrast to the usual custom, the "Guerchais" had its ailerons on the leading edge, after the fashion of wing slots.

Although a speed range of from 25 to 80 m.p.h. and a ceiling of 17,000 ft. was claimed, this snappy little plane did not create much of a furore in aviation circles. So it is surmised that unforeseen difficulties arose, probably in the matter of control, since any plane which could attain 80 m.p.h. on a 20 h.p. motor would receive plenty of attention if everything else was right.

Fauvel himself has built several "All Wing" airplanes, all of them more or less successful. His latest, built this year, is shown in Fig. 5, sketched by Mr. Hoffman. This Wing weighing 560 lbs. is powered by a British Pobjoy engine, rated at 75 h.p. which imparts a speed of 112 m.p.h.

As can be seen this performance does not stack up with that of other Flying Wings, and while the ship has the safety characteristics of the others, it would seem that M. Fauvel's design lacked something.

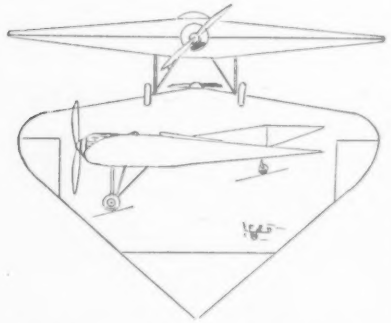


Fig. 7. The Kite-Wing invented by Lawrence Lesh.

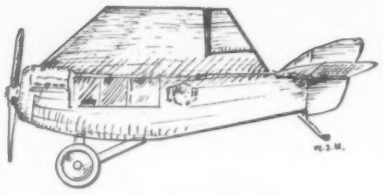


Fig. 6. The Bat-Wing patent by William Stout.

The large wheels, not shown in this view, and the poor streamlining of the engine might offer enough parasitic resistance to account for the lack of speed, and, too, it must be remembered that the horse power increases at a far greater rate than the speed. At any rate, we can look to M. Fauvel for further interesting developments in the near future.

The first of the low aspect ratio Flying Wings was designed and built by William Stout. As can be seen, a conventional fuselage is employed, even to the tail surfaces (Fig. 6). This design was very poorly engineered, and may be said to have flown in spite of the large chord, which is its only resemblance to a Flying Wing. However, it must be remembered that this was at a date when the science of Aeronautics was still a bit young.

Stout took out a patent on his design in 1919. In the drawings he shows a plane slightly different from the one he had already constructed. It had a tubular fuselage starting about half way back on the wing, and extending some distance in front. However, he retained the tail surfaces, which flared out from the rear of the wing.

It was difficult to decide in which class to put this plane as it has many of the characteristics of both, while the unique use of tail surfaces earns it a class by itself.

About the same time, Lawrence Lesh took out a patent on a Wing that was evidently never constructed. His design covered two types, both with a very low aspect ratio. The first, shown in Fig. 7, taken from the patent drawings, tapers from a swept back leading edge to a point in the rear, forming a triangular elevator.

Triangular ailerons are set into the wing, which entirely encloses the pilot. The second design showed a plane similar to the "Stout," on which the usual trailing empennage is used. The Lesh patents were taken out shortly before those of Stout.

In 1919 Captain James V. Martin, designer of the M series of air foil sections, used on most Flying Wings, made many tests with reflexed, low aspect ratio wings, using ratios of 1 and 1.3. He was discouraged, however, to find that the lift drift ratio was reduced. More recent tests show that the increase in maximum lift which has been previously explained, can be utilized to overcome the reduction in L/D.

It is interesting to note that the Americans seem to be the most enthusiastic boosters of the low aspect ratio Flying Wings. Knowing the remarkable astuteness of the American people, one cannot help but think this fact significant. A half dozen Yankees may be wrong, but there is a much greater chance that they are right.

Dr. Cloyd L. Snyder was a contented chiropodist. One day he tried to glide some paper insoles, but found they would not perform well without the addition of a rudder, whereupon they glided satisfactorily. From this humble beginning, he devised a machine which finally evolved into the well known "Arup." However, his patent calls for a gas-filled wing and he never really intended to build the "Arup." Fig. 8 shows his original machine, which was only a full sized model, being incapable of control or of lifting a man. It had a span of 20 ft., a chord of 13 ft. and a thickness of 14 in.

Dr. Snyder planned a 320 ft. "Dirigiplane" to take the place of Zeppelins. Powered by several motors, the plane was to make possible such flights as a non-stop hop around the world.

This idea had already been patented by Woyevodsky, whose 1919 basic patents covered also all planes in which the fuselage takes the form of a wing section, thus including the Burnelli planes and many Flying Wings. Desiring an expert opinion to present his plan to the Goodyear people, he called in Raoul Hoffman, who had been interested in Flying Wings since around 1910.

Upon making a study of the situation, and conducting many windtunnel tests of the design, they decided to discard the gas idea and concentrate on an All Wing airplane. A company was formed with stockholders to finance the work, and in 1933 the first "Arup" was built.

It had a span of only 19 ft. and a chord of 14 ft., with an area of 211 sq. ft. Powered by a 40 h.p. Continental, this tiny ship attained a top speed of 97 m.p.h. with a landing speed of 23 m.p.h., a speed ratio of better than 4 to 1. Needless to say, its performance was characterized, as is the case with all Flying Wings, by its resistance to stalling and spinning. The usual set of controls was used, being connected to wing tip ailerons and an elevator, as well as to a vertical rudder.

So gratifying was the performance of this first "Arup" that another was started almost immediately. Shortly after it was completed, and before any sort of tests had been made on it, this machine was mysteriously burned. Construction was thereupon begun on a new ship which utilized all the valuable experience that had been gained by the previous work.

This latest ship differs from the other model in that it has horizontal tail surfaces over the rear end. The area of these

(*Concluded on page* 71)

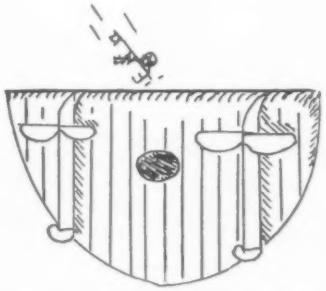


Fig. 8. The Arup flying-wing devised by Dr. Schneider.

The NATIONAL AIR BOARD *Says*— *Unbiased Opinion to Further National Aeronautics*

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Grover Whalen
E. Burke Wilford
R. C. Wood (Paris)

ALEXANDER KLEMIN, CHAIRMAN

WITH the Chairman laid low by the fashional but annoying influenza, Mr. E. Burke Wilford presided ably and vigorously at the eighth meeting of the Air Board.

Most welcome guests at the meeting were Miss Thea Rasche, the distinguished German aviatrix, Vincent J. Burnelli, whose designs are now being built under license in England, and Prince di Castelcicala de La Tour of Palermo, Italy, an authority on Italian aviation.

The Air Board pursues the policy of extending a welcome to well informed personalities in aeronautics and its proceedings are both enlivened and enlightened by such visitors.

ALL FIRST-CLASS MAIL BY AIR

The British Air Ministry has just announced that beginning April 1st it will inaugurate faster and more frequent schedules on the London-Cape Town run when a fleet of the new Short Brothers flying boats will be put into service. It is most significant that mail over this route will be carried without the usual flying surcharge and that this is the first step in an ambitious program under which all first-class mail will eventually be carried by air throughout the British Empire. The Air Board responded with interest to the question:

SHOULD NOT ALL FIRST-CLASS MAIL BE CARRIED BY AIR?

Captain Depew thought it was only logical that all mail should be delivered by the fastest and best available carrier without any premium. He thought that the people of the United States were fully entitled to such service.

At the advent of train travel no distinction was made between mail sent from New York to Chicago by train and that carried from one western city to another by horse and buggy. The cost to the public in either case was identically the same and the Post Office in those days just used the best available method of delivery whether by train or horse or pony express. He did not see why this should not be the case today.

As a matter of fact a considerable amount of first-class mail, not specifically marked Air Mail is even today carried by air between New York and Chicago so as to enable certain of the transport ships to carry their full mail load.

It is also well known that the Post Office generally makes quite a profit out of air mail stamps. If all first-class mail were carried by air, the volume of airborne mail would increase enormously, costs would go down accordingly, and a nation wide system of air mail at ordinary costs would be perfectly feasible.

A motion of August Post was seconded and unanimously adopted: *"The Air Board recommends that the Post Office Department work steadily towards ending the present surcharge for air mail on all first class mail and that it should send by air all first-class mail wherever and whenever possible."*

REMARKS BY MISS RASCHE

Miss Rasche expressed tremendous admiration for the aviation progress shown in the United States since her last visit. Miss Rasche thinks that we have the best sport, transport and military planes in the world (possibly excluding some of the Junkers craft from this statement).

Discussing the Transatlantic Air Races to be held this spring in commemoration of the Lindbergh Flight, the German aviatrix thought this to be a most admirable gesture—yet she questioned the value of the undertaking.

All the advantages that can be derived from pioneer solo work have already been achieved. Solo flights across the Atlantic might possibly end in accidents and crack-ups and do aviation more harm than good.

Transatlantic flights in large machines when properly organized, such as by Pan American, were in her opinion of far greater importance and would be more likely to advance aviation. Referring to the renaissance of glider flying in Germany, the distinguished aviatrix stated that power gliders were now being used more and more but the engine in such power gliders was used only for take-off and after this the glider became independent of fuel and was used purely as a soarer. This system of take-offs with power makes the

Future progress in airline transportation and passenger safety lies as much or more in the training of the mechanics as the pilots.

glider independent of car towing and other methods of launching and therefore has interesting possibilities, as the Board fully agreed.

AERONEUROSIS

Captain Harry Armstrong, director of the Physiological Research Laboratory of the Army Air Corps, writing in the Journal of the American Medical Association, sets down the conclusion that 50 per cent of pilots over 30 years of age are afflicted with aeroneurosis. He defines this as a "chronic functional nervous disorder occurring in aviators."

Quoting a newspaper article—"It was found in tests upon an unselected group of 163 pilots of all ages, to begin with very small percentages in the lowest age groups, and rise to more than 50 per cent in those between 40 and 50—unfitting them for flying in what should be the most useful and proficient years of their lives.

"The nervous strain of flying—bearable for years, but cumulatively mounting to the point of breakdown—was assigned as the reason for this sharp upward curve."

It appears to members of the Board that while Captain Armstrong is undoubtedly an authority on aeronautical physiology, that this was nevertheless another instance of the tendency of medical specialists to lay undue emphasis on some aspect of their studies.

Readers, perhaps, will recall a recent announcement by a well known psychoanalyst that Alice in Wonderland was an example of sadistic mind calculated to ruin the lives of children forever! According to Mr. Wilford psychologists are apt to say that 50 percent of the people are deranged.

There is no doubt that Captain Armstrong's studies are not to be treated lightly. Nevertheless his views were not upheld by well informed members of the Board.

In some cases, where a pilot's work falls off, it may be a matter of "concentrated entertainment" rather than aeroneurosis. Captain Depew, who has been flying now over 25 years, and shows as much skill and freedom from accidents as ever, made a very good point that altogether too much stress is laid on the physical condition of the pilot and not enough on his judgment, experience and knowledge.

Pilots need not be 100 percent perfect physical specimens. They need not be athletes. The researches of the Physiological Laboratory might be all right as far as they went, but there are a great number of pilots over 40 years of age who are flying the airlines in all kinds of weather and doing a good job of it.

It was the consensus of opinion that until further information was available the conclusions of Captain Armstrong were open to criticism, and it would be an unfair hardship on pilots were the public to entertain the erroneous idea that a man over 30 years of age could no longer be trusted to fly.

AIRLINE ACCIDENTS

The most important topic brought up for discussion at the 8th meeting was the question of airline accidents. A number of definite questions were placed before the Board.

a. What should the Air Lines do to reduce such accidents?

b. What should the Department of Commerce do to reduce such accidents?

COMPETITION AS A SOURCE OF ACCIDENTS

In all fairness it is necessary to set forth the view that competition among the airlines themselves is one of the causes of accidents. Perhaps the best way to set forth this view is to quote from a letter by Captain Depew.

"In approximately the past two weeks, we have had five very bad air line crashes, four of them when actually flying the line and the fifth on a test flight. These were:

"The crash of the Western Air Express air liner, presumably killing all occupants —some 7 or 8, I believe—no trace of the wreck having been found as yet.

"The crash of the Northwest Airways ship, killing the pilot and co-pilot, the only occupants of the ship, and apparently destroying considerable mail.

"The crash of the Eastern Air Line ship, piloted by Dick Merrill, without loss of life, and with minor injuries to occupants, except in the case of Merrill, who was painfully and somewhat seriously injured.

"The crash and burning of the Braniff Airways ship at Dallas, killing all occupants—I believe 5—who were employees.

"The crash of the Pacific Air Transport Boeing, near Saugus, California, killing 12.

"Of these, all except the Braniff accident were ships flying on regular schedule. Every one of the four was due to bad weather. All ships were presumably equipped with the most modern aids to air navigation, including two-way radio, although I do not know whether any of them had radio compasses. All of them crashed in the mountains.

"I consider that the great majority of air line crashes today is due to a wrong operating policy. I believe that the lines are pushing the personnel and the equipment too far, and beyond the limits of a safe operation. They are trying to fly with passengers in weather which is too bad for safe operation, despite radio aids, etc.

"Radio is a tremendous help to flying—in fact, it is indispensable to scheduled operation. But, notice that I have said 'indispensable.' When the radio goes out of commission, it is extremely dangerous and

(*Continued on page* 66)

Troop-carrying and bombing were the missions of this British Vickers 163. It's powered with four Rolls-Royce' Kestrel engines and was a dangerous foe in anyone's country.

"....Clear and Unlimited"

by SWANEE TAYLOR

Our versatile commentator, in his highly interesting and entertaining manner, makes pertinent remarks concerning doers and doings in aviation.

CERTAIN dour murmurings drifting back to my ears here of late make it evident that this department's stand on some matters is still a bit fuzzy. This is probably due to an unfortunate literary style which lacks clarity and to-the-pointness. It seems that the customers—too many of 'em—have an idea that I'm agin' things. Well I'm not, not by a jugfull. In fact the only sin of commission I can't abide is a selfish, underhanded abuse of our beloved Aviation. Or, to put the policy bluntly: If it's on the up-and-up and isn't overdressed in the spangles of publicity, I'm for it.

Our Commentator, Swanee Taylor.

Read that last sentence again, please, and you can't fail to grasp the utter simplicity of both my private and my reportorial philosophies. It is the old "cold turkey" school of thought; you know, no fancy trimmin's. And whereas it's plain fare, folks, it's mighty good for insomnia resulting from troubled conscience and/or a conniving sense of judgment.

So, Hooray for everything; particularly that ever-swelling army of men and women who deserve our every thought and consideration. I mean the Great Buying Public.

Press Relations . . .

A crying need in the Industry today is a better comprehension of that overwhelmingly potent Dr. Jekyll-Mr.Hyde influence, the American Press. The sooner we win the newspapers over to our way of thinking—by coming out in the open with everything and by being sweet-as-'lasses-candy to them—the sooner we will dry up a source of irritation which rises to plague us whenever disaster strikes.

Personally I don't think that the Press or anything else can hinder the steady march onward and upward. Shucks, we couldn't impede it ourselves with our numerous blunders and occasional bursts of boneheaded smugness. Witness, please, the phenomenal development through the past sad decade. There is nothing in history of man to equal it save possibly broadcasting and bootlegging. None-the-less most of the boys wax wroth to the point of apoplexy whenever they see a crack-up story in print. Lordy, you should watch their veins swell and quiver. Which, in itself, is sufficient reason to analyze the distressing effect and maybe apply a poultice.

The best way to keep crack-up news out of the papers, naturally, is to quit cracking-up. But apparently this remedy is too simple; man always feels cheated if the cure isn't a little complicated. However, try as we will, there is nothing complex about getting a fair break from the daily papers. There is only one other way to do it, and this method is, strictly speaking, almost as simple as the first one mentioned.

Here is all there is to it: We've got to stop whacking hell out of cameramen who arrive on the scene of an accident. There is no surer way of "getting the works" in a news story than for the city editor to hear that his reporters and photographers were roughly handled.

Oh, I know it is galling to stand-by and watch them photograph a wrecked airplane, particularly if it is torch-off. But brawling at such a time doesn't help a dead brother, nor does it honor him. Far better for his sake to keep our heads and lend every effort to build up as much dignity around the catastrophe as possible. Besides, somebody (a passerby, a visitor or some perennial snapshot-Bill), will get a picture anyway and sell it to the papers. And you may rest assured that a "stolen" picture is ever played-up as a distinct journalistic "triumph."

By way of illustration take two of the December crashes. In one instance the reporters and cameramen got pretty rough treatment. The result, *"Six Die in Flaming Airliner!"* in banner headlines, plus, of course, horrible pictures showing the fire at its height. At the other one, however, the gentlemen of the press were accorded every kindness, consideration and courtesy. The result, nice little shots taken from the rear of the wreck made it look like the pilot had done a marvelous job of squatting down in the trees. While the story treatment made him out to be somewhat of a gilt-edge hero.

Another thing we'd better start doing immediately is to tell the newspaper boys how it could have happened. Explain all possible causes painstakingly and carefully so as to prevent guesses which invariably reflect unfavorably on flying. We all know that every crash analysis narrows down to two, or three at most, causes. Explain these probabilities to the reporters, then you can expect a sensible, sympathetic treatment in the news story.

Another thought in conclusion: Any pilot worthy of the name would want the world to profit by his final mistake. Ours is an unselfish business—it'd better be—and every manjack in it must be willing for his manner of going to be public property; hence somewhat of a sacrifice.

Flight Stewards . . .

First to inflict Air Hostesses on the traveling public, Eastern Air Lines has taken the lead in rubbing Sex out of air travel. No longer, praise be, does the hapless male embark on their ships to be tormented to the landing by a cheery, willing aerial Geisha girl.

The Flight Stewards, handsome fellows in movie mansion monkey suits, come as a welcome change. And despite their slightly dumb uniforms these young men give every sign of fitting snugly into the air transportation picture. As a Washington-bound lady across the aisle put it, they remove the nursery atmosphere from the ship and make everything seem more businesslike.

Requirements for the job are: not over twenty-five years of age, 5 feet 8 inches tall, 150 lbs. maximum weight and an attractive presence. Considerable emphasis is placed on resourcefulness and personality, for the company realizes full well that they are goodwill plenipotentiaries to the traveling public at large.

Some of the boys are licensed pilots while quite a few of them are college grads. None of them, however, aspires to the job of air line pilot. Rather they foresee a bright future in the traffic end of this business of flying folks through the air. They feel that meeting the customers aloft, studying their needs and requirements will serve as an excellent training ground for this future. None of them, I might remark, hopes to marry a rich passenger—preferably aged.

Perhaps I'm telling tales out of school, but this change from belles to boys is the result of a tireless two-year campaign by the wife of the General Manager. I hope Mrs. Rickenbacker will forgive me, but I had to prove that women are so much smarter than men—on the ground.

Naval Intelligence . . .

Some time back I did a piece on Naval Aviation Cadet training in which personal views on the subject were freely mingled with straight reporting. Happy to say, substantiation of these opinions came forward in the person of Gardner Randall when he was home on Christmas leave.

(*Concluded on page 62*)

A hostess—one of the author's pet peeves, preparing a meal in her miniature galley.

United Air Lines' Douglas "Skylounge"

The United Air Lines' Skylounge Mainliner in flight.

THE new Skylounge Mainliner of United Air Lines made its aerial debut in January by inaugurating 3 hour 55 minute non-stop service between Chicago and New York, to be followed by three-stop coast-to-coast flights in February.

Featuring an installation of fourteen deep-cushioned swivel chairs in a cabin ordinarily accommodating twenty-one standard seats, the Douglas-built Skylounge offers greater comfort and more spacious accommodations than any other transport in regular service, United officials claim. Ten of the company's $3,000,000 fleet of 28 DC-3 type ships are of the exclusive custom-built Skylounge model, ten are the standard 21-passenger type day-planes and eight, for delivery in the spring, will be sleepers.

United's non-stop Skylounge flights between Chicago and New York are the world's first and only extra fare air schedules. An extra fare of $2.05 is charged on Skylounge service, raising the one-way full-fare rate from $47.95 to $50.00. United officials determined on the extra fare because of the luxury of these Skylounges, added to the non-stop feature, as United cut its payload from twenty-one to fourteen passenger seats.

Other outstanding features of the Skylounge cabins include steam-heating, air-conditioning, sound-proofing that lowers the decibel count to a point lower than Pullman cars, rich appointments and upholstering in blue, brown and cream, real silver, china and linen for hot meal service, bridge tables, binoculars for observing scenery, individual hassocks, personal toilet kits for men and women, special game equipment and intra-plane telephone.

The Skylounge Mainliners also rank as the most powerful passenger land-planes in domestic service, marking the first U. S. domestic installation of the two-row 14-cylinder Wasp engines developing 1150 h.p. each. With its fully loaded weight of 12 tons, the Mainliner can climb on one engine to 9,500 feet and attain a twin-engine ceiling of 23,000 feet.

Note the unusually roomy interior of the United Air Lines' Skylounge Mainliner.

Aviation Is in Reverse—Why and Wherefore

DESPITE the millions of words of publicity to the contrary, Aviation has been going backwards. Much has been said of the tremendous speeds our transport planes develop, how pretty the stewardesses are, and the brand of cigarettes the pilots smoke. Yet, where are we?

It cannot be denied our planes are marvels of speed, the stewardesses are the prettiest, and the cigarettes pep up the pilots. However, John Q. Public is much more interested in his well-being, and also his pocketbook, than in these facts.

It is awfully nice to step into a plane and be whisked off at a two hundred mile per hour rate. But, consider the facts. In the conventional airplane, a speed of two hundred miles per hour or more is accomplished only by sacrificing some more important advantage. For instance: A popular transport plane develops a top speed of about 230 miles per hour. Some traveling.

But, this same craft lands at over sixty miles per hour. Take your car up to sixty and see how soon you can stop it. Then figure what distance a craft, weighing five or six times the weight of your car, would require to stop at such a speed.

It is a simple matter for an experienced pilot to land a fast craft on a well laid-out airway with surfaced runways, boundary lights, and radio directions. Very seldom do you hear of accidents on a well organized field. However, when a heavy fog bank lays down or a bad storm makes it impossible to reach the airport the pilot must set down on a two by four emergency field or perhaps he is unable to reach an emergency field. He then must search for a clearing of some sort to put her down.

Of course, it is admitted the country could use many more emergency landing fields. This is partly the fault of meddling politicians, but not entirely. If you have ever been in mountainous districts, you will appreciate the difficulties encountered in locating a level spot of sufficient extent to allow one of these streamlined tornadoes space to set down.

Coupled with the small size of these emergency fields is the handicap of poor visibility. They are used mostly when weather or mechanical conditions prevent further flight. Imagine driving your car in a pea soup fog at sixty miles per hour.

Despite these handicaps the accident rate of our airlines is extremely low. The radio beam and pilots versed in blind flying are doing wonders. The radio beam has also the misfortune of being in the control of politicians. In one section of the country, to my knowledge, one radio beam serves four different lines, whereas it should serve only two. This was largely the cause for a recent accident in which several people were killed. The beam led the pilot several miles off his course with the result he crashed in the mountains.

A study of airplanes and engine manufacturers will make a person believe the Garden of Eden really originated in China

(*Concluded on page 65*)

Dr. Robert H. Goddard, Rocketeer

by ALVIN EDWARD MOORE

This is the second in a series of articles on this subject by Author Moore which deals with America's No. 1 rocket man and space navigation exponent. Dr. Goddard started this work in 1909

IN 1877 Giovanni Schiaparelli, an Italian astronomer, looking at the planet Mars through a powerful telescope, discovered a series of straight lines extending from each of the polar caps of the planet toward the equator.

These lines, he calculated, were fifty miles wide and several hundred miles long. Reasoning that no straight lines are found in nature on the earth, he concluded that the lines might be made by intelligent beings—and he called them *canali—the canals of Mars.*

A great interest now flamed in the scientific world concerning this neighboring planet of the earth which for long had been held capable of supporting life similar to world man.

Percival Lowell, an American astronomer at Flagstaff, Arizona, began studying the canals. For seventeen years he worked on the problem they presented; and when he died he was more than ever convinced that they were irrigation canals built by man-like beings to conduct water from the polar ice caps over the drying surface of their chilling planet.

The great two-hundred inch telescope which should be finished and installed in the new observatory in Southern California by 1940 may let us know more about these probable man-like beings; but only the space-ship can carry World man to Mars or our other neighboring planet Venus and bring him back for a tale that will make Columbus' report seem like the story of a very humble exploration.

June 9, 1931. R. H. GODDARD 1,809,271
PROPULSION OF AIRCRAFT
Filed June 26 1929 3 Sheets-Sheet 3

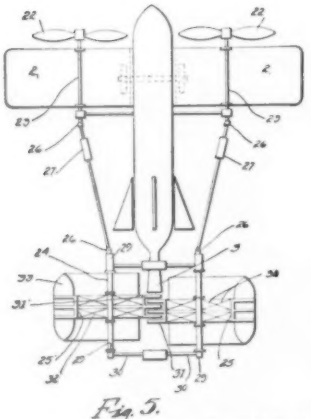


Fig. 5.

Robert H. Goddard Inventor
by Charles E. Kennedy Attorney

Dr. Robert H. Goddard, prominent physicist, is shown beside the first liquid fuel rocket (oxygen and gasoline) just before it was sent up on March 16, 1926.

In the future, a number of possible ways of propelling such a ship through the vacuum of interplanetary space may be evolved.

In his story "Journey in Other Worlds", John Jacob Astor imagined a force he called *apergy* which would cause the earth to repel a space ship.

In "The First Men in the Moon", H. G. Wells told of a spherical space ship covered with a new substance called *Cavorite* which resisted gravity. Rolling back that part of the *Cavorite* which pointed toward the moon allowed the moon to exert an attraction on the craft and thus move it through space.

Substances which permit the utilization of magnetic attraction and repulsion to propel craft through space might be found or created in the future. If such were used, in the opinion of the writer, one of the poles of the earth would be used for taking off from the earth, to repel the space craft, and the other for landing, to attract the space craft through the depths of space.

It is not impossible or even improbable that some day the great electric force of the auroras of the North and South Poles will be harnessed by man, and perhaps used in some way in propelling air or space craft. The earth like every other polarized object must have a positive and a negative pole.

One may attract the electricity of these auroras from space and the other shove it away. There may be the germ of an idea for propulsion in this—but like all such beginning ideas it is nebulous and fanciful.

The fact remains that only one means of propulsion through space that is at present practical has been proposed. This is the rocket motor, whose early history was described in the last article.

About the end of the first decade of the Twentieth Century practical scientists and inventors, with solid reputations to uphold, became interested in the rocket as a means of propulsion. The rocket idea of the early dreamers was being accepted by science as practical.

In 1909 Dr. Robert H. Goddard, an American physicist, became interested in the problem. In 1912 he began making calculations of possible rocket flights through space. In spare time from his work as professor at Clark University in Massachusetts he made many experiments and calculations.

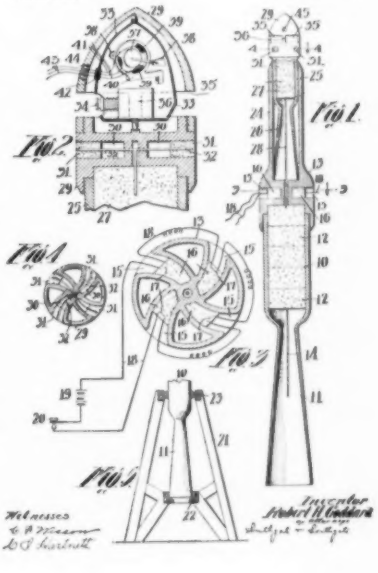
In 1918 the Smithsonian Institution of the United States published his report on the practicality of sending rocket ships to the moon.

Shortly afterward came the published reports of two Europeans who worked alone and yet were co-workers of Robert Goddard—Dr. Hermann Oberth, an Austrian scientist, and Dr. Walter Hohmann, a German. These solidly trained scientific men of Europe and America were unanimous in the opinion that the rocket could be used as a means of reaching the outermost part of the atmosphere, and also for trips out into space with distance of travel limited only by the amount of fuel that could be taken with the craft.

Dr. Goddard of America carried on his researches with a grant of funds from the Smithsonian Institution. Dr. Oberth of

R. H. GODDARD.
ROCKET APPARATUS.
APPLICATION FILED DEC 1, 1913.

1,102,653. Patented July 7, 1914.



Witnesses
G. A. Mason
D. F. Hartnett

Inventor
Robert H. Goddard
by Chandler Bradley & Dodge
Attorneys

XUM

Austria published a more complete treatise on the problem of rocket flight in 1923.

Enthusiasm, fired by Oberth's researches, the famous French engineer and inventor in aviation, Robert Esmault-Pelterie, who had been interested in the rocket since 1907, now began to work intensely on its problems. His aim was to convince the conservative, traditionally skeptical and practical French scientific world of the glorious possibilities of this dawning means of travel and exploration.

Now came the men of action to take chances in testing the crude new device—the dare-devil ones whose reckless courage light up the early development of every means for carrying man on into the advanced future. Professor Max Valier of Munich, Germany, a young German of French Huguenot ancestry, born in 1895; Fritz von Opel, the young wealthy automobile manufacturer and sportsman; Friedrich Sander, a pyrotechnicist; and in America Robert H. Goddard who sent up his first test rocket propelled by liquid fuel (gasoline and oxygen) in March, 1926, at Auburn, Massachusetts.

Goddard's little model rocket rose 184 feet in 2.5 seconds; and its flight satisfied him that he was on the right path toward solution of the problem. But he saw that the rocket was at present a dangerous thing; and he decided that test rockets should be fired electrically from a safe distance.

In early 1928, Max Valier interested Fritz von Opel the young auto manufacturer and sportsman in his studies in rocket propulsion. Valier, von Opel and Sander the pyrotechnicist began work on a rocket car. . . .

May 24th, 1928. The Avus Speedway at Berlin. Two thousand men and women in the stands—invited there for the first public trial of a rocket-driven vehicle—high civil government officials, officers of the Reichswehr and the German Navy, men of the press, people high in the scientific, technical and social worlds.

The car stood on the track, looking like a small racing automobile. But from its sides projected two tiny wings, like airplane wings except that their angle of incidence was negative instead of positive; the wings were not set to cause the craft to fly *but to hold it down on the earth.* Twenty-four powder rockets were housed at the tail of the car, to explode through tubes arranged in a rectangle.

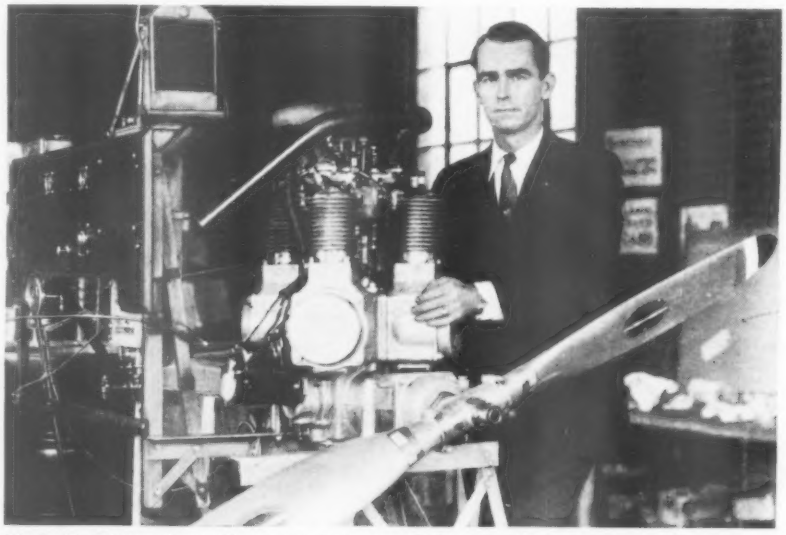
Fritz von Opel walked to a radio microphone. He was a slender young man—twenty-nine years old—with a long face and square chin and well-formed features—handsome, with bold eyes that had just a hint of his dreams in them.

He began talking of the attempt to break the automobile speed record that he was about to make, to demonstrate the feasibility of rocket propulsion.

"Our next step," he continued, "will be the construction of airplanes able to develop a speed of four hundred kilometers an hour. In the fourth stage experiments have been planned to propel rocket planes up to a height of 30 kilometers, with only animals aboard, in order to ascertain

(*Continued on page* 58)

THE NEW DENEHIE ENGINE



W. A. Denehie, "Early Bird" and designer of this new 85-horsepower job, is shown here with the finished product on the test stand.

EARLY BIRD DENEHIE has a hunch that the world is on the threshold of a new era in transportation. The only thing lacking is an airplane low enough in cost to so spur sales as to enable mass production.

An "early bird," in aviation vernacular, is any person who flew an airplane prior to 1916. And Denehie is W. A. Denehie of Cincinnati, who first started to fly back in 1911, and who follows up his hunches. At present he is working out production problems on a new engine which he believes will revolutionize the aviation industry.

"A faster, more direct and more comfortable means of bringing our destination closer to us will be universally accepted just as soon as it has been discovered that a reliable airplane can be purchased and maintained just as inexpensively as the lowest priced automobile of today," he says.

"Once the average man learns that he can cut loose from his earth-bound existence the low priced airplane will come into general use, just as surely as the automobile replaced the horse and buggy."

Denehie believes he has perfected a low-cost engine that will bring the airplane within reach of the average citizen. It will be a flivver plane, substantial and safe, but still costing little more than a moderate automobile.

The Denehie engine has a minimum number of parts, for one thing, especially wearing parts. It has a delivery at the propeller of 85 horsepower with a weight ratio of slightly more than two pounds per horsepower. It has four cylinders, air-cooled, barrel-type, with geared propeller shaft. It is designed to operate at a normal engine speed of 2500-3500 R.P.M.

It is designed to run in a horizontal position and is mounted longitudinally in the nose, on 4 engine-legs. It can also be used as a "pusher-type" if desired. The overall length (measured from tip to propshaft) is 29½ inches. The frontal area can be completely enclosed in a space 22 inches by 22 inches. There will be no projections beyond the cowling except the tailpipe of the exhaust manifold and the carburetor air-scoop.

The castings are all of aluminum alloys, heat-treated, and are designed to be made by the "permanent mold" system. All other parts are of heat-treated steel alloys, each alloy selected for its known ability to deliver the best service in the specific part in which it is to be used. Cylinders are 1-piece, aluminum alloy castings with shrunk-in, steel liners of a high, wear-resisting ability.

A duplex pump provides full force-feed lubrication circulation to all internal parts of the engine.

Tests have shown that fuel consumption does not exceed .48 lbs. B.H.P./Hr., and the oil consumption does not exceed .0114 lbs. B.H.P./Hr.

All parts of the engine are readily accessible for replacement, adjustment or repairs. No special tools are necessary.

The unique design, Denehie believes, provides a balancing means whereby objectionable vibration is reduced almost to zero. He also points out that although it is the primary intention to build single-bank engines for flivver-type airplanes, larger powered engines can be provided by merely combining multiples of the power-banks into engine units.

The engine is designed intentionally for a low-priced field and the eventual price will be governed by the extent that demand would permit of volume production. The price range will be between $3.00 and $6.00 per H.P.

The engine, according to Denehie, has been approved by the U. S. Bureau of Air Commerce.

XUM

Penaud—Father of Flying Models

by CHARLES PLANCK

While Penaud was really more than a pioneer in designing flying models, yet he is of more interest from the model standpoint than he would be as a designer of full-scale planes. He was a man far ahead of his time in every essential qualification and a most versatile inventor.

IN your imagination, pick up an imaginary Paris paper for the summer of 1876 and turn to the advertising pages. Read:

FOR SALE, AEROPLANE: Flying wing type amphibian; streamlined, enclosed nacelle; thick wing section; metal, wood, or cloth covering; monocoque spars; retractable landing-gear; air-spring shock-absorbers; skid brakes for landing; streamlined wing floats; retractable steps on hull; balanced control surfaces; upturned trailing edge; streamlined wire bracing; two all-metal propellers, adjustable in flight; novel stick control; automatic pilot; weight, 2460 pounds; speed, 60 miles an hour; accommodations for pilot, mechanic and one or more passengers. Special high speed planes built to order. Alphonse Penaud, 14 Rue de la ——.

You must use your imagination because Penaud lacked even the nomenclature so to describe the airplane which he patented. He could never have written such an advertisement even though he did conceive the plane.

Alphonse Penaud's father was an admiral in the French navy and he had destined his son to follow the same career. A hip disease prevented this parental aspiration but the disease, tragic as it was, compelling the younger Penaud to hobble through life on crutches, might have been unimportant if the skepticism and unconscious cruelty of his fellow scientists had melted before the searching intelligence which he brought to bear upon aeronautical problems.

No more tragic story appears in the history of aviation's pioneers; few more brilliant conceptions of human flight can be written after any name on aviation's roll of honor and accomplishment.

Penaud was born in 1850. He built and flew with perfect success three types of flying models: a flapping wing device, a helicopter, and a small "model airplane" powered with twisted rubber bands. This latter, a monoplane, is the actual forerunner of today's model airplanes, and it became an important item in the childhood

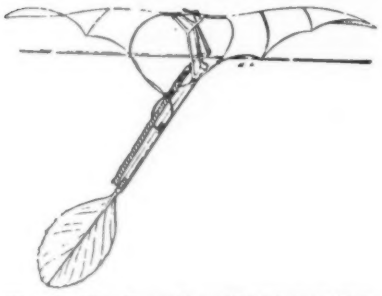


Fig. 2. The Penaud ornithopter of flapping wing model that emulated bird-flight.

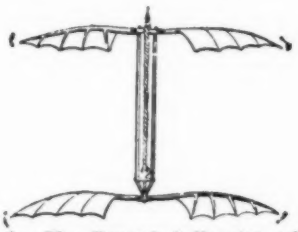


Fig. 1. The Penaud helicopter which proved to inspire the Wright Brothers with a desire for scientific investigation.

history of our own Wright brothers.

He climaxed his short and amazing career with the projection of the plane described in the imaginary ad, a model of which he built and flew in a wind of nine miles an hour, minus crew and engine. Ridicule, conservatism, jealousy and general human pig-headedness drove him, "one more unfortunate, rashly importunate," to his early death.

From about 1870 until the date his patent was announced, he was an honored and active member of the French Society of Aerial Navigation. The reports of their meetings repeat his name more often than that of the president. His remarks on all subjects occupy more space than those of any other member.

In 1876, the reports of the society included specifications which he filed on his plane patent, but thereafter no mention of him is made until 1880 when the president announced his death and made perfunctory remarks typical of such an occasion. One of these remarks, constituting a posthumous evaluation of Penaud's work, makes a fitting, if reserved, epitaph for him:

"The name Penaud should be inscribed among those who have contributed most to the development of aeronautics."

Some disagreement arose between the society and Penaud about the time his patent was awarded. The annual reports of the society are entirely barren of his name between 1876 and the 1880 official recognition of his death. With nearly all the details on his personal life lacking, we must assume that this severance of happy and satisfying relations with his fellow scientists, coupled perhaps with their disbelief and ridicule, must have had a motivating effect upon his suicide.

One account says that he placed his works in a "small grave" (or vault) and went to his home and shot himself. This was before he was 30.

His Planophore was the first mechanical model ever to fly. He was the first to abandon the use of a bent piece of whalebone or spring as motive power for small propellers. He quickly established that the rubber band in tension was several thousand percent more efficient in delivering its power than other crude methods and dropped them at once. That was characteristic of him.

His Planophore told volumes about his approach to the problem of flight. It consisted of a stick frame 20 inches long. Just back of the center of gravity was a fragile wing 18 inches in span. Near the other end of the stick was a smaller wing, corresponding to our horizontal rudders, and set at a negative angle to overcome the effects of the advanced center of gravity. The propeller was 8 inches in diameter and of the pusher type.

In 1871 Penaud made the first public demonstration of this device before the French Aeronautical students in the gardens of the Tuilleries. It flew 131 feet in 11 seconds.

His flapping wing device was similar in general appearance and also actuated with rubber bands in tension. With characteristic insight into the practical aspects of human flight, he spent little time on this, knowing that flapping wings are the prerogatives solely of the birds.

Penaud was bright enough to understand that the pectoral muscles of the bird constitute two-thirds of his body structure while the muscles that man might use for flapping through the air comprise less than one-fifth of his entire muscular equipment. In these 55 years since Penaud died, how many individuals, otherwise intelligent, have failed to see and appreciate that simple point!

His helicopter, like the Planophore, appealed to the commercial instincts of his contemporaries, and soon both became toys for children, on sale in stores. The helicopter consisted of a stick about 10 inches long with four feathers, arranged as two-bladed propellers at either end, revolving in opposite directions.

Twisted rubber bands produced the power and this helicopter could rise quickly to a height of 50 feet, or rise about 20 feet and hover for almost half a minute. Very important in these experiments was the fact that landings did not wash out the apparatus. It could be flown again and again without rebuilding, making possible serious and continued study.

Bishop Wright, the father of Wilbur and Orville, bought a Penaud Planophore commercial adaptation and took it home to Dayton to his eager, alert sons.

Today's model airplanes, very much im-

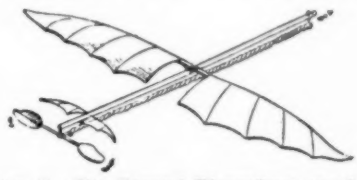


Fig. 3. The Penaud Planophore or the progenitor of the present flying stick model.

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proved and refined, of course, still are direct descendants of this early scientific brainchild of Penaud. Therefore, he should be honored by the young makers and launchers of model planes as something of a patron saint. The most coveted trophy for international competition among these bright youngsters should be called the Penaud Trophy.

Penaud was a disturbing and interesting member of the French Society. His papers were lucid and penetrating. Members found it difficult to follow him. He went from point to point in his theses without explaining the intermediary steps which to him were already perfectly clear.

In competition with the best minds of France he won a prize of 2,000 francs for a paper on a deep mathematical subject. He wrote frequently to a member of the British Aeronautical Society, apprising him of the activities of the French Society and contributing his thoughts to current aeronautical discussions.

Penaud was a skilled worker with his hands. He made his own fragile models and we might concede, in our pride, that he did work as fine and accurate as some of the present day model builders in our high schools. His Planophore weighed 0.56 ounce. But when it came to the construction of larger apparatus, he recognized his handicaps and associated himself with a clever mechanic, Paul Gauchot. Together they obtained a patent from the French government for the airplane which incorporates so many of the details about which our designers are bragging today.

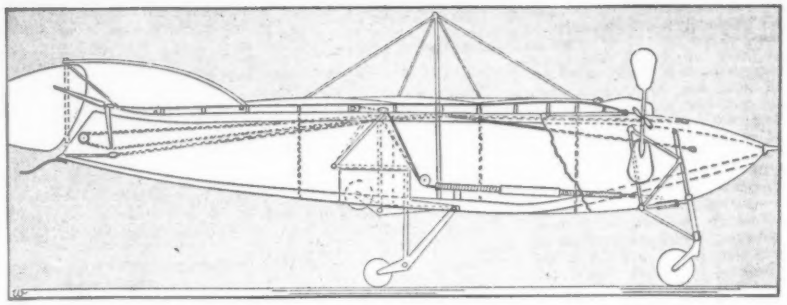
Oddly enough, as recently as 1925, Penaud's patent came into semi-public notice when J. V. Martin was suing the U.S. government for infringement of his patents on the retractable landing gear. Alfred V. Verville had used a retractable landing gear on the racer he had built for the Army in 1924, and which attained a speed of 246 miles an hour.

Department of Justice agents, seeking to combat Martin's suit, delved into the Patent Office and the stacks of the Congressional Library and discovered the dusty, forgotten drawings and specifications submitted by Penaud to the French patent office, and so established that the idea of retractable landing-gear had been definitely conceived in minute detail in 1876.

They found that even before that date, du Tempil had drawn plans for a landing gear that was to be withdrawn against the body of the plane in flight. Martin contended that neither of these devices had been used on a plane which flew, and the Justice agents had to look further, finally finding additional evidence. The suit is still pending.

Army Air Corps workmen built a model from Penaud's drawings and have written specifications for use in court. The model still hangs on the walls of the office of the Chief of the Patent Division, awaiting more court hearings on the Martin suit.

While Penaud was not the first to conceive or plan the retractable landing-gear, he was easily the first to conceive the many radical details of his plane that make it a marvel in aeronautical history. Let him tell in his own words, using the cramped and inadequate vocabulary which that early day forced upon him, of the kind of an airplane he would have built if broader vision and a more tolerant understanding had supplanted the discouragement that killed him. These are the words of the specifications which he filed in obtaining his patent:



A complete assembly of Penaud's inventions shows many features in common use today, one of which is a retractable landing gear.

"Our invention relates to an aerial flying apparatus which can carry in the air one or several passengers. This apparatus belongs to the category of aeroplanes or inclined planes acting upon the air like kites and propelled horizontally by aerial propellers.

"The apparatus is formed like a bird, of two halves symmetrical as regards a vertical plane directed from the front to the rear. It possesses a large surface inclined at a small angle to the horizon and adapted to sustain it in its flight. It is provided with two propelling screws located in the two sides of the body of the apparatus at the front of the sustaining surfaces and actuated by a powerful mechanical motor.

"It is provided at the rear, for controlling the inclinations, with two hinged horizontal rudders. It is provided, for steering, with a substantially vertical hinged rudder. These three rudders are worked with the aid of a transmission by a pilot who is placed at the front, in the body of the apparatus, and whose head projects outside the body; a lever placed at the front, like the beak of a bird, guides the eye of the pilot.

"A vertical steering plane exists at the rear. Four spring feet, provided with rollers, allow the apparatus to start and to land tangentially upon the ground. The body of the apparatus, or car, has a quadrangular transverse section, and a general shape adapted to cleave the air. This car is located directly under the sustaining surface and is rigidly connected thereto.

"The apparatus being thus described in a general way, we will now describe each part."

Here note the sane and understandable descriptions of the elements of this remarkable "flying wing." Search through the specifications with a fine toothed comb and no more than three or four impractical ideas can be found. Engineers can dust off their twentieth century nomenclature and shorten this account to a couple of paragraphs, but they and the writing man must join in marveling at Penaud's clarity of description and depth of inventive insight.

"We reserve the right to use either metals or wood or any other resistant material in the construction of the ribs (by ribs, he means spars), the slats (ribs), and of the border of the wings . . . We reserve the use of these materials either in pieces or whole, or in tubes with sections of various shapes, or in double T pieces . . . tubes with triangular and quadrangular sections, also with transverse partitions from point to point, like natural bamboos, of which we also reserve the use. These tubes can be in sheet metal or formed with the aid of three or four boards, glued, nailed or screwed together, with an external covering of cloth coated with strong glue and internal partitions of light wood. (The monocoque spar!)

"We reserve the right in forming the lower and upper faces of the sustaining plane, as well as all other external surfaces of the apparatus, the use either of materials such as silk, cotton and cloth, either varnished or not, or metallic sheets or veneer . . . We reserve the right in the case in which the surfaces of the wings shall be of sheets of metal, or veneer, to do away with the slats (ribs)."

Polishing, painting, lubricating, varnishing, coppering, nickeling, gilding and all metallisations would be used to protect these surfaces from the action of air and moisture.

"The wings are strengthened by a system of rope bands comprising two small masts forming props, and by a system of lower rope bands which are fastened by their lower extremities to the bottom of the car . . . We reserve giving to these rope bands either a round form or a flat form, or any other section adapted to cleave the air. If it is necessary, we will provide them, on the back side, with small fixed vanes, adapted to prevent them from vibrating. We reserve covering our rope bands with protective sheaths, and with paint.

"We reserve the right to omit, in our aeroplanes, and especially in those of high speed, either simply the system of rope bands which are above the wings, or the totality of the rope bands.

"The spread of the sustaining surface is greater than its breadth taken from the front to the rear, each of the two wings can be either entirely plane or preferably arched slightly. Stable equilibrium fore and aft is obtained during flight by turning up the whole or a part of the rear border of the sustaining surface; this effect is very important."

The one thing omitted in Penaud's consideration was the aileron, but it is probable that some such device was contem-

(*Continued on page* 52)

Blind Flying at Wright Field

by CHARLES J. BAUER

TO consider the merits of a system of training pilots in blind flying and blind landing by use of a dummy airplane incorporating standard controls and the very latest navigation aids, a board of five officers from various army fields has been deliberating at Wright Field, Dayton, procurement center for the air corps.

Newer still than the ground trainer is another system, developed at Wright Field under direction of Capt. Carl J. Crane, whose researches in radio control resulted last year in development of a method of tying together the army radio and the directional gyro for complete automatic navigation.

The new training method permits the student to learn blind flying and landing while receiving credit for flying time, since even his first lesson is given while in flight. The system, considered by the army board at the same time as the ground trainer, is made possible by a set of radio control knobs in the instructor's cockpit, connected with the student's standard instrument panel.

The student, in the front cockpit of a two-place training plane, is under a hood that resembles the collapsible top of a perambulator. The student manipulates the controls but the instructor has dual controls, for possible emergency use. The instructor is not hooded.

Before the student are only his controls and the standard instrument dials. His only other contact with the outside world is telephone communication with the instructor. The neophyte is completely at the mercy of the latter, for by means of the radio control knobs the radio compass needle can be made to move in any direction.

The new development is primarily a radio control system by means of which the instructor creates radio destinations at will: a tree, a hill, a silo, a farmhouse or a village too small for a radio station becomes a radio destination at the whim of the instructor.

He can make the radio compass needle point to the hypothetical station, visible over the side of the cockpit, simply by turning a knob, and in that way can study the student's reactions and create a variety of blind flying problems.

Essentially the radio compass of the air corps, as developed at Wright Field, is a means of flying straight to a selected radio destination merely by tuning in on that station, and flying in such a way that the compass needle points always straight up. Actually, in a crosswind, the pilot flies so that the needle "leans" from windward to offset drift. This system is distinguished from the one in general commercial use, which follows air lanes, that is, radio beams. Around its radio compass system, which permits flying from any point direct to destination, the army has built its blind

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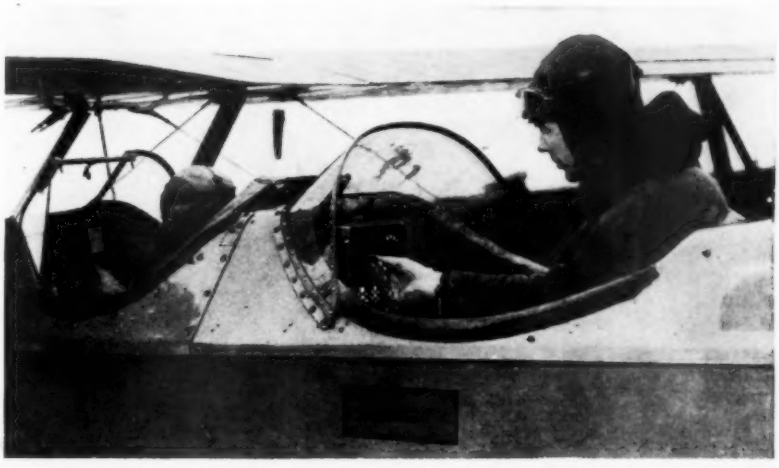
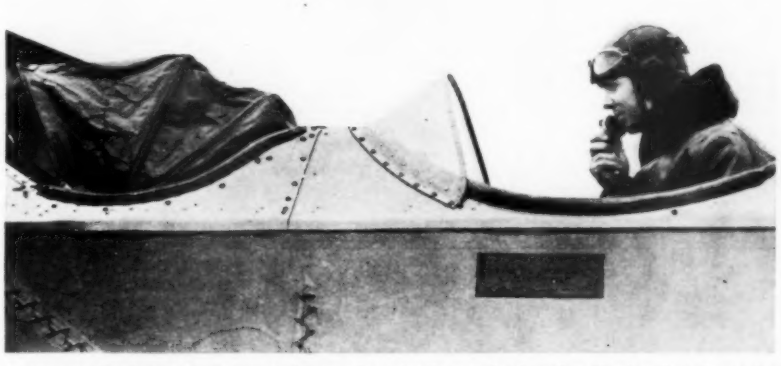
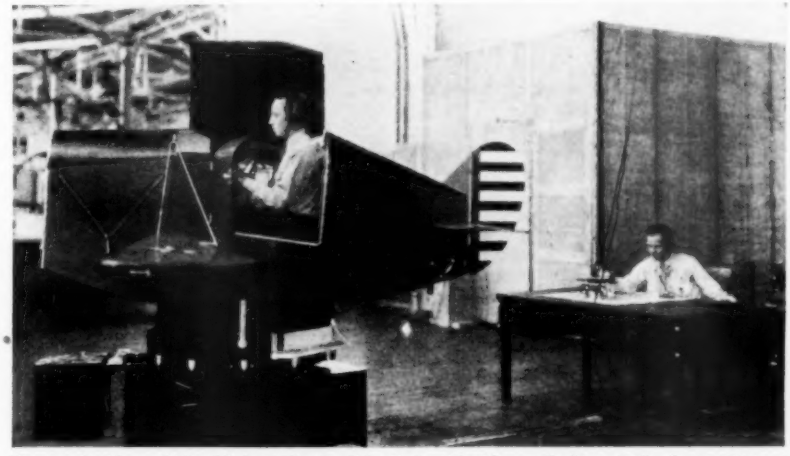


The instructor turns the radio compass control knob to cause the needle on the student's dial to turn right or left, independently of any actual radio reception.



An Army Air Corps instructor gives orders to the student under the hood and manipulates the radio control knobs on a special panel to create training problems.

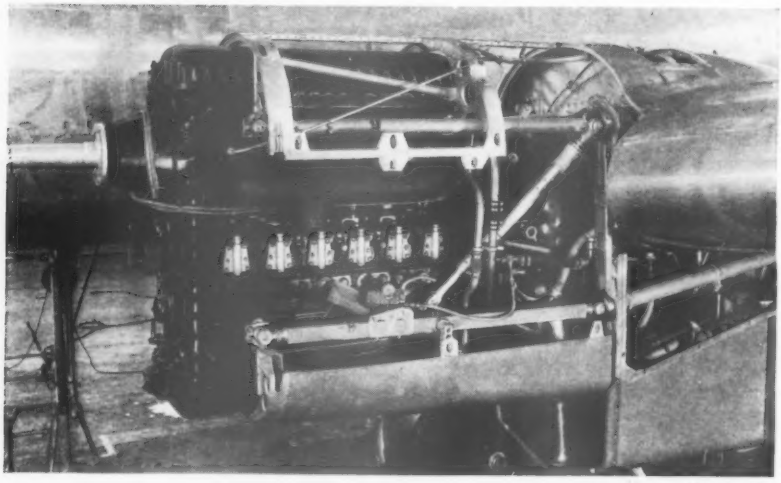


Demonstration of the Link trainer with student in the cockpit and the instructor at the table. The device on the table records the flight operations carried on by the student in the car.

A History of Diesel Engines

by

JOHN B. KENNEDY



A compression-ignition fuel oil engine (Diesel) mounted in a Junkers Ju-86.

DURING one recent week I flew more than ten thousand miles with a companion to visit some of the plants of the leading Diesel manufacturers in the United States from the Atlantic to the Pacific and back again, including the world's largest builders of Diesel power.

As a layman unskilled in the comprehension of any engineering problem more complicated than the operation of a pin-cushion or a shoe-horn, I can only say that while this extensive and intensive trip had me in the air a good deal of the time, it also left me in the air, at its conclusion, over the surprising present and the vast potential future of the Diesel engine.

It so happens that as an inquiring reporter I've been in about every form of vehicle and vessel powered by Diesel. In the giant airship Hindenburg as it glided with haunting smoothness under dappled New England skies; in the gallant liner Lafayette slicing the furious Atlantic; in the Burlington Zephyr and the Flying Yankee as they clipped the gleaming rails at a sustained speed of 100 miles an hour; I've been in Portuguese and Italian fishing boats seining shrimp and sardines in the Pacific, which wasn't so Pacific at the time—but Diesel power scorned its bumps.

I've been in a passenger-car powered by Diesel to rip off an unrippled and unclattering ninety miles an hour. I've even ridden a Diesel-powered tractor. Indeed, about the only thing I've missed is a wheel-chair powered by Diesel, and even at that I was pushed around the Atlantic City boardwalk by a guy who pronounced his name that way although he spelled it differently. So I claim a perfect score as a traveler benefited by Diesel power.

Yet, for any technical description of Diesel I must rely on quoting the engineers of the various companies who with the utmost consideration for my inquisitive ignorance gave me all they had learned and far more than I can ever absorb—for with me, the higher technicalities simply go in one ear and out both.

Dr. Rudolph Diesel, inventor of the Diesel engine, whose memory was honored by a luncheon held recently in New York.

Yet the drama of the Diesel I can understand, for it is alive and striding. It brings a new process of easier and cheaper power—power that is the motive force of our mechanized civilization, that provides us with more comfort and convenience and so accelerates the progress of the standard of living, and makes for a richer human life, which may in time lead to a more reasonable human life.

It's a strange coincidence that the dawn of the drama of the Diesel should have been marked by something more than drama by the lurid mystery of melodrama in the fate of its inventor.

Rudolf Diesel, the genius whose boon to mankind is being honored today on the fortieth anniversary of its introduction into the United States, vanished from the world of the living without explanation before or after his demise. Many of you recall vaguely headlines of twenty-three years ago, and some of us may even have tried to forget them sooner than this.

But on the front pages of September, 1913, appeared the report that Rudolf Diesel, famous Paris-born Bavarian inventor, had vanished from the channel-steamer Dresden on its crossing from Antwerp to London. His bed on the boat had not been slept in. Nobody remembered having seen him—and not only had Diesel vanished but also important papers he was known to be carrying for conferences with British authorities, presumably over Diesel power for submarines. Remember the date was proximate to the opening of the World War the following year.

Complications were added to the mystery of his disappearance by a telegram received by his family, and traced to Geneva, saying he was safe—although a body recovered from the sea was identified as Diesel.

There are conflicting reports as to the state of his fortunes at the time; but the best informed opinion is that he was in good circumstances, as the subsequent condition of his surviving family appears to attest.

But although there is this tragic note to his career, the memory he left behind is one of triumph in the legacy of boundless power he bequeathed our industrial age.

To put his vision into his own words, uttered, incidentally when he was being honored by America on a tour of the great commercial countries of the world—this is what Rudolf Diesel said before the American Society of Mechanical Engineers.

"The Diesel engine has doubled the resources of mankind as regards power production, and has made new and hitherto unutilized products of nature available for motor power."

Diesel concluded with this peroration that was also, in the light of events, a prophecy:

"I must call to your mind," he said, in his almost accentless elocution, "the fact that nowhere in the world are the possibilities for this prime mover as great as in this country."

Their Operation and Progress

Could Diesel pay a return visit to the United States he would find that this country which he called great had indeed realized his vision, and that it was pressing on even beyond the frontiers of his foreseeing —to outstrip the rest of the world in the manufacture and varied use of Diesel power.

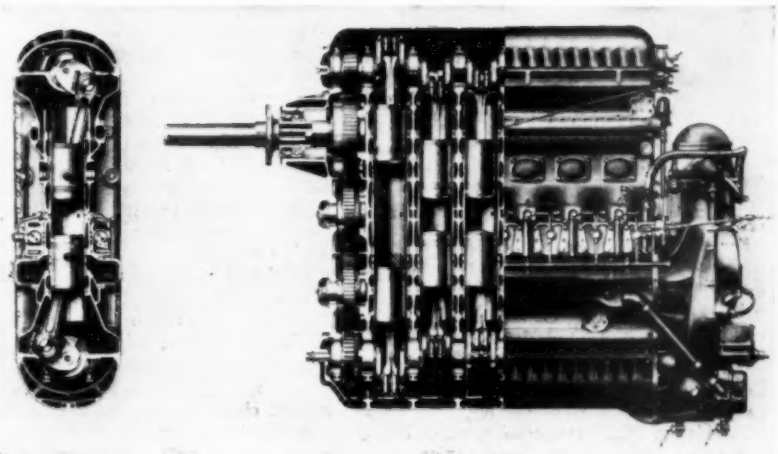
Rudolf Diesel first had the impulse to seek an efficient and inexpensive power machine when he was a student in the Munich Technical College. He had made laborious research into the origin and development of power—from the crude, copper-boiler grandfather of all steam engines, attributed to Hero, the Greek scientist and inventor in 130 B. C., to the most powerful steam and gasoline engines of his time. He took everything in his stride, Watts' original wagon-wheel steam engine, Huyghen's Gun Powder engine which blew powder into cylinders and almost blew its inventor into smithereens.

Diesel was particularly stirred by the frequent and sharp criticism of one of his physics instructors, who held in low esteem the efficiency of the gasoline engine of the nineties. He pointed out continually to his students what he declared to be the waste in internal combustion engines, and from him, doubtless, Diesel had the first gleam of an idea for a different and more efficient principle.

He patented his first engine in 1892, and the original patent set forth his claim to have devised an engine to burn powdered-coal blown into the engine cylinder by compressed air, although he averred that any kind of fuel, liquid, gaseous, or even solid could be so used.

That first engine built by Diesel in Germany exploded and was thoroughly wrecked, and Dr. Diesel himself suffered serious injury. His path as an inventor was by no means as smooth as the performance of his invention.

He persisted and, finally, forty years ago, brought forth his first commercial engine, a single cylinder 25 horsepower unit of a clumsy pioneer design resembling very much an old-fashioned coal-mine cage engine. But it worked and it worked well, and its success spurred him to constant improvement. Important engine-builders sought licenses from him, and the engine was soon in manufacture in Germany, England, Italy, France, Switzerland and in America.



Sectional views taken through the Junkers aviation Diesel engine, showing the crankcases at top and bottom and with the combustion chambers in the center of the bores. The expansion takes place between opposite pistons without a piston head.

Other minds contributed to its improvement, but nowhere has that contribution been more important than in the United States, where native ingenuity has so advanced construction and design that Dr. Diesel himself, if he saw the latest Diesel engine coming off the line at Peoria would recognize his principle without identifying the product—for in appearance there is hardly anything to tell apart the compact modern Diesel from the handsome gasoline motors of Detroit and elsewhere.

Adolphus Busch, a public benefactor to whose art I, for one, have often joyfully attested, brought the first commercial Diesel engine into being in the United States—a two-cylinder sixty horsepower unit—in St. Louis.

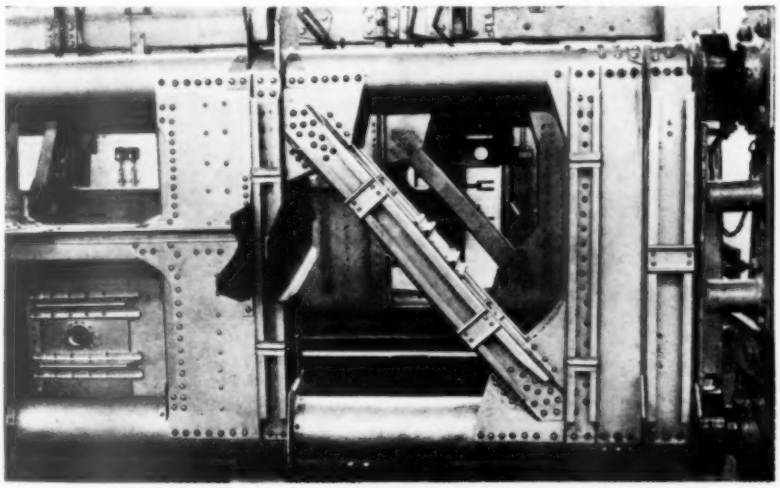
It had the prime fault of the Diesel engines, that is, of the early Diesel period, inasmuch as its weight was about 400 pounds per horsepower, whereas an automobile engine only weighs about ten or twelve pounds per horsepower. This weight differential has been slowly but successfully minimized, until now the Diesel looks or looms—whichever way you view the matter—like a practical future competitor of the gas engine for lighter motorcars.

Differences in the weight of the two types of engine are obvious; but what is their difference in principle? The research engineers explain this vital difference in language that even I can understand.

Internal combustion engines convert the heat of natural fuel into work in the cylinder of the engine itself. All internal combustion engines are therefore fundamentally similar. But despite this similarity, there are vital differences in both fabrication and function. In the gasoline engine, through carburetion, the fuel and air are mixed before they enter the cylinder.

In the Diesel, the fuel and air are mixed inside the cylinder. The gasoline engine compresses a mixture of gasoline and air which is ignited by an electric spark. The Diesel engine compresses only a charge of air. Ignition is accomplished by the heat of the compression.

Therein lies the substance of Dr. Diesel's



Another Diesel installation in a Junkers Ju-86.

XUM

great discovery. That brings about the difference in the compression ratio and expansion ratio, which, in turn, begets the difference in fuel that spells the decided operation advantage of the Diesel type over gasoline engines in heavy duty power-production.

To put it simply, as research engineers do, the Diesel engine is a high compression internal combustion engine. Thermodynamics prove that the higher the compression ratio in an engine, the more efficient it can be. When an engine is said to have a compression ratio of 6 to 1, this means that the volume above the piston is six times as much when the piston is at the bottom of its stroke as it is when the piston is at the top.

For example, a cylinder that would hold six pints with the piston at the bottom of the cylinder and one pint with the piston at the top of the cylinder, and you get a six to one compression ratio. But when the capacity of the cylinder is sixteen pints when the piston is at the bottom and one pint when the cylinder is at the top, the compression ratio is sixteen to one.

That is the Diesel compression ratio. It means that the air in the Diesel engine is squeezed not to one-sixth of its volume as in the gasoline engine cylinder working with gas and air mixed outside the cylinder—but in the Diesel engine the air is squeezed to one-sixteenth of its volume when the piston rides to the top of its stroke. The Diesel compression heats the air to one thousand degrees Fahrenheit, then misty sprays of oil are injected—not raw crude oil as erroneously supposed by many, anatomy of the Diesel—the explosion occurs and the engine goes to work. It is all a matter of molecules, and the Diesel principle, as I see it, is to make air do as much work as oil in the ignition and operation of the engine.

But I'm not going to let the research gentlemen get off so lightly in my paraphrase of their explanation. To find a homely simile to illustrate the Diesel principle I went to my wits' end, without having to travel very far. But engineers liken the essential functioning of the Diesel principle of compression of air so that fuel will start burning by itself as soon as it is injected in the cylinder, without the aid of electrical ignition, to the ignition of flashing grease in a frying pan. What could be simpler?

The trick with the Diesel is to inject fuel evenly—evenly to microscopic smoothness so that when it hits the hot air the fuel is vapor, not liquid. It is this technique that has brought into being the precision parts that are revolutionizing Diesel manufacture and which, in turn, seem destined to revolutionize the entire art of internal combustion power production.

The first Diesel engines used compressed air to blow the fuel oil into the cylinders. Air at over 1,000 pounds per square inch is necessary to inject and atomize the oil. This is just about the water pressure half a mile down in the sea. An average size bathroom would contain a ton of air if it were at this pressure and without the presence of a bathroom baritone.

Some Diesel engines built today use a

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A New Cellular Multi-Spar Wing

THE development of a new airplane wing, known as Multi-spar Cellular wing, by A. S. Barcley, Detroit, has created a stir of interest in aviation circles.

Claims made by the designer are to the effect the new wing is stronger and lighter than the conventional type now in use. It is also practically invulnerable to gun fire.

That these claims have merit was attested when the U. S. Navy gave the Barcley-Grow Aircraft company a contract for a wing to be tested, and the U. S. Army Air Corps is following closely the developments. In explaining the structure and pertinent phases of the new wing the designer said:

"The Barcley Multi-spar wing was designed for the purpose of obtaining the maximum strength weight ratio from a stressed skin wing by supporting the skin at frequent chord points with continuous spanwise members.

"In the XBT-1 outer wing panel this continuous support was obtained by a multiplicity of full-length, spanwise webs so arranged that the wing is composed of uniformly tapering full span cells.

"To complete the identity of a spar as a beam a stiffener has been added at the top and bottom and this, together with a portion of the skin, constitutes the flanges, or chord members."

The Barcley-Grow Aircraft company aside from the development of the Multi-spar wing and an all steel propeller, which officials claim might easily result in replacing the entire wooden propeller market, is engaged in the construction of a twin-motor, eight place transport.

It is anticipated this new plane will be completed the latter part of January. Commander H. B. Grow, associate of the company, in commenting upon the new plane claims it will fill the gap in American airline equipment. Professor Klemin of the

(*Concluded on page* 70)

A glimpse of the wing structure.

Capt. Anderson Heads Department at Rantoul

Capt. Anderson, in a moment of leisure, scans a copy of POPULAR AVIATION.

CAPTAIN HERBERT W. ANDERSON, of the U. S. Army Air Corps, and at present director of the Department of Armament, Air Corps Technical School, Chanute Field, has had a very extended experience in military aviation.

He graduated from the U. S. Naval Academy in 1917, from the Air Service Primary Flying School in 1925, from the Air Service Advanced Flying School in 1926, from the Chemical Warfare School, Field Officers' Course, in 1928. He reported for duty at Chanute Field in 1930.

While at the school he served in the following capacities: Secretary, Air Corps Technical School; Director, Department of Clerical Instruction; Post Adjutant. He is, at present, Director of the Department of Armament, Air Corps Technical School.

Born July 11, 1894, in the State of Montana, was appointed Major (temporary rank) on July 24, 1935. He was appointed Captain (permanent rank) on August 1, 1935. He is rated as an airplane pilot and airplane observer.

Wartime Plane Production

THESE statistics are of interest to all who believe the next Great war will be fought largely in the air:

Russia has 11 factories which can turn out more than 2,000 airplanes a year. Great Britain has 35 airplane factories, 14 of which are used exclusively to fill Air Force orders. Germany has 17 aircraft plants, one of which employs 15,000 men.

France has 32 aircraft factories, all subsidized by the government and ready to place their facilities at the disposal of the government at a moment's notice.

Akron's First Lightplane

by HELEN WATERHOUSE

This home-built lightplane, built by two Akron boys, has received an unusual amount of publicity in the public press and elsewhere because of its Ford powered plant.

THE X ship, Akron's first and only plane powered by an automobile engine, returned last week from a successful cruise to Florida—one of the thirty small ships which cruised down to the Miami Air races from Cincinnati, flying in formation.

This is the ship, a duplicate of which has been ordered by the government. The designers and owners, Joe and Howard Funk and Pratt Jones, are at present busily at work on the government ordered ship.

Piloting the "X" ship on the cruise was Joe Funk, and co-pilot was Bernard Wade of Akron, another former glider pilot. Bernard gave this description of their trip upon arrival home.

"We left Akron at 11.30 a. m. and reached Cincinnati in 2 hours and 55 minutes.

"Everything went O. K. The next morning we joined about 15 other ships and all of us left for Louisville, reaching there in 1 hour and 15 minutes. It was very hilly country.

"The next day we gassed up and went to Nashville, a trip which took us two hours and 44 minutes. From there we went to Chattanooga—in an hour and 34 minutes. On this lap we went over some very bad territory. We then pushed on to Atlanta where a couple more ships joined the cruise. At each city newspaper men asked us lots of questions and the Chambers of Commerce gave us banquets.

"From Chattanooga it took us one hour to fly to Atlanta, then 53 minutes to Macon. We were held up there by weather and stayed over night there. The next day we left for Waycross and got off about 8:23 a. m. We flew an hour and 20 minutes before we discovered the oil line had broken. All the oil ran out of the motor and we noticed the pressure gauge was zero. We started immediately to look for a field, but they were few and far between. There seemed to be nothing but woods and corn patches, but we finally found one.

"Joe overshot the first field, and gave it the gun to go around again, but the motor would not take it and we just zoomed over a bunch of trees and down into a corn patch.

The Funk Ford powered lightplane in flight makes a neat looking arrangement and reports indicate that its performance is equal to its appearance.

Clarence Chamberlain (left), who took a flight in the Funk plane, is discussing its performance with Pratt Jones, one of the designers.

"I had to walk about 2 miles to get some oil while he got the motor fixed. When we started up the engine, everything seemed to work swell, so with the help of a lot of farmers we cleared a strip of corn and made a runway for Joe to take off. Then I got the farmer to take me about 40 miles to Waycross. The weather had turned bad and we stayed in Waycross overnight.

"The next day the weather was fair enough so we figured we would try to get around the bad weather by flying down the center of Florida instead of down the east coast. So we left Waycross for Lake City, Orlando and Miami. We got away at 8.54 a. m. There was about 800 foot ceiling most of the way to Valdosta and our course was right down a highway. Everyone arrived Okay. From there we went to Lake City, and the course was again right down the highway. On the way the ceiling dropped down to about 150 feet. This meant that we just brushed the tree tops. We could not turn around because of danger of running into other ships. Boy, were we glad to get there and so was everyone else.

When we arrived in Ocala the weather was clear and the sun shining. When we got to Orlando we were in the heart of the orange grove section and its was marvelous scenery. When we landed at Orlando it was so hot that Joe and I got a headache.

We waited at Fort Laurel for everyone to collect and go to Miami in a bunch, flying formation. We slept in a small cruiser on the ocean in Miami and went swimming all the time. We found a speed boat which we ran, and which was rather a change from the X ship. The races were swell."

XUM

Civilian Flight Training vs.

Civilian pilots, because they are civilians, are generally confined to Saturday and Sunday afternoons for their aviation training.

by

PAUL D. HERSEY

Who puts in a plea for the civilian trained pilot.

I WAS trained by a civilian instructor, a misfortune according to my Army graduate friends to be rated in the category of smallpox.

Since the day, my two buddies returned from Langley Field, Virginia, with four hundred hours apiece and two pair of overlarge silver wings on as many puffed chests, my ability as a pilot has taken a terrible slandering, both privately and in public, which is not only embarrassing but extremely annoying.

The opinion of all military flyers seems to be that the civilian pilot is an awkward clown who clutters up the airways with his useless putterings around and claims the title of "pilot" because he can land a ship and walk away from it. This is a narrow and unfair attitude and in defense of my clan I protest.

In the first place, compare the training methods used at Randolph Field, the Army Primary Training Base, with those used by leading civilian schools. You will be surprised to learn that the commercial institutions are much further advanced in many phases of teaching.

For example, take the policy now in use by a leading school in the Northwest, whereby students are given their first hours at the controls of an airplane under the hood, flying by instruments and unhampered by any preestablished feel. This is but one of the many forward steps made by civilian flying schools which, in contrast to the military, are forced by competition to be constantly on the watch for improved methods.

Why should the Army or Navy strive to better training conditions; they are turning out pilots who meet their requirements and that is sufficient. A commercially operated flying school must do more than produce pilots who satisfy the Bureau of Air Commerce. In order to maintain its standing in the business and keep the cash rolling into the till, it must attempt to turn out flyers superior to those of other schools.

And the civilian flies for the love of flying with no ulterior motives in view.

To which organization would the loss of a plane or student mean more, the military school, fed by the yearly appropriation of Federal funds, or the privately financed civilian school, that depends on efficient, accident-free operation for its goodwill and cash profit?

It is obvious and natural that the latter would take greater pains to protect equipment and personnel. Considering equipment alone, the average modern training plane costs in the neighborhood of three to five thousand dollars. That might represent a good share of a year's net profit to even the largest civilian school. The loss of a student, regardless of cause, means loss of public confidence, the most valuable asset the school may possess.

Enough for the training angle. There is other work to be done toward the enlightenment of misguided war birds.

Show me a cadet in the Army or Naval Air Corps who has ever flown behind less than two-hundred horsepower. It is natural that men trained and accustomed to flying in heavily-built, well powered ships, should develop a tendency to substitute horsepower for horse-sense; in other words, depend upon a husky power-plant rather than skill to carry them through a maneuver. (I can hear the fellows at Barksdale and Selfridge giving me the royal "moo" for that last remark.)

A private flyer is taught from the beginning that he must not expect a mere ninety or one hundred horsepower to work big miracles. He learns that a lack of power reserve may be compensated for by greater caution and finer usage of the inertia of his ship. As the glider pilot scorns all power plane pilots, so the civilian who trundles about in his little Kinner powered Fleet scorns the military pilot charioting along behind a four hundred and twenty-five horsepower Wasp.

The civilian believes that it just "isn't cricket" to take credit for flying ability when all one has to do is point the nose of the ship in the desired direction and hold on tight (keep your seats, boys; no rough stuff 'till after the performance).

Perhaps the reason for this attitude lies in the fact that our private flyer, untainted by the "fly-to-kill" training of his brethren, is something of an artist able to appreciate the rhythmic beauty of an intricate maneuver performed sans horsepower. (Hearts and Flowers, please.)

And last—here is where we really get insulting; the ego of the military pilot does not exist in the makeup of the civilian. He has no pretty uniform with which to impress the public; he is not a power bird of war and in the presence of the fully bedecked warring element is a sad mister indeed.

Still, humility has its virtues; the plain clothes pilot has no reputation to uphold in the eyes of the groundling; he may fly as conservatively as he pleases, with the knowledge that he is disappointing no one. On the other hand, let a visiting Army pilot take his P6E off the local port without making a pass at the Grim Reaper, and the gathered throng will yowl its disapproval.

The average civilian knows that he is not the hottest thing on the stick. He knows also that the ground is very hard and that an airplane after all is just wood, metal and fabric. With this knowledge he goes forth and more often than not lives to caution his grandchildren against the evils of being a "throttle-pusher."

(*Concluded on page 57*)

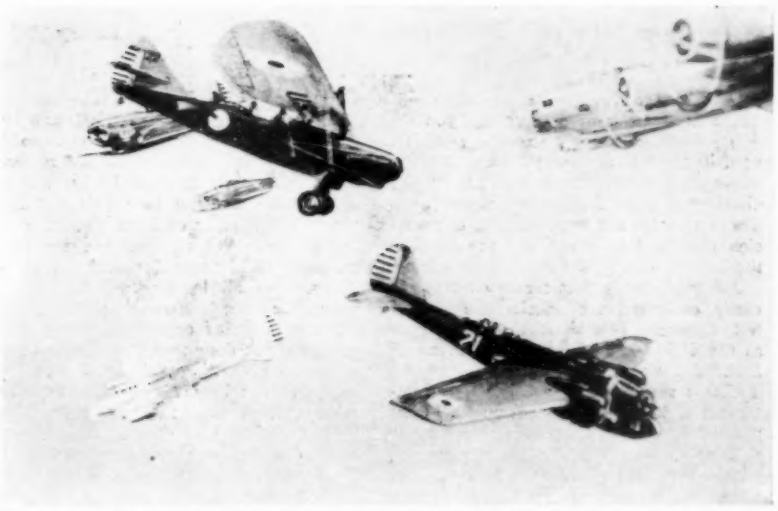
XUM

Military Flight Training

by

T. S. TERRILL

Who sets forth the views and viewpoint of the army flyer.



The army pilot has training on all sorts of ships under all flight conditions and becomes an expert—because he has nothing else to do during seven long days.

IT IS true that most Air Corps pilots look with disdain on civilian flyers. And after nine months of mingling with the local civilian fraternity as a civilian pilot, I am forced to conclude that the power birds of war, so called, are justified in their attitude in many respects.

Let me make clear my position in this argument. Prior to entering Randolph Field, I had the whole sum of one hour and forty minutes of dual instruction—and that was taken from a civilian pilot who may have had fifteen hours solo time. So for all practical purposes it may be assumed that my entire flight training was in a military flying school.

I graduated from Kelly Field and spent several months on active duty at Langley Field, but for the last nine months have been separated from the Service and have flown in civilian ships as a civilian pilot —under ticket TR 32829.

I do not propose to sneer at civilian pilots. Having been exposed to the ease with which Air Corps Cadets pile up hours at government expense, I am highly conscious of the difficulties under which most civilians must labor for flying time. Nevertheless, I have noticed certain glaring weaknesses in the attitude and technique of the civilians with whom I have flown and talked—faults which contribute greatly toward justifying the superior attitude of military pilots.

Before an Air Corps Cadet ever gets off the ground he gets a nice lecture on the meaning of two words—"accuracy" and "precision." He is told that almost anybody can get a ship off the ground and back down again, all of which doesn't mean a thing if the job isn't done in a clean-cut, positive, accurate, and precise way.

It is also pointed out to him that there is no virtue in a three-point landing in a tree top or in the last forty feet of a field. He is shown that the entire year's course is built around certain basic exercises the first and final purpose of which is to develop accuracy, precision and more accuracy.

The result is that Cadets are exposed to accuracy and precision exercises hour after hour and day after day until they become accuracy conscious and are ashamed to be seen executing a maneuver or a landing that isn't clean and precise.

My log book shows 320 hours of pilot time through graduation day at Kelly Field. And it shows that *over half* of those hours —167 of them—were spent on Air Work and Accuracy!

And here we are with more army gyrations not included in the civilian training routine.

They were spent doing 90, 180, and 360 spot landings, hurdles, pylon eights, strange field landings, down-road eights, chandelles, lazy eights, and cross-road eights. The remaining 153 hours were divided between aerobatics, instrument and radio beam, day and night formation, and day and night cross country.

In one year of training at the Air Corps Flying School, I logged exactly 13 hours of aerobatics!

The point is this: your military pilot is good, not only because he has expensive equipment and powerful engines, or because he has hundreds of hours in the air, but because he is forced to take pride in developing a flying technique which has two goals—accuracy and precision. He is forced to admit that there is more, much more, to flying than getting off the ground and back down again. If he won't admit it, he goes home quick like.

He develops this technique, not by power diving on grandstands or by doing formation loops, but by getting up there in a clumsy old trainer and chandelling himself blue in the face, and continuing to chandelle until he can do it right.

From what I've seen around the local airports (there are fifteen of them in the immediate vicinity) the average civilian thinks that because he has a license he's a pilot. He's far more interested in the crowd lined up along the fence than he is about his ability to land on a spot. And until brother civilian takes his mind off the grandstand and throws the pulp air thriller into the corner he's going to remain ridiculous in the eyes of his military counterpart.

There's no one to force him to anything. He's going to have to do it himself. He's going to have to realize that the airplane definitely does not make the pilot; that there are a mere half dozen basic maneuvers, the mastery of which will make him a pilot; that these same basic exercises are within the reach of all pilots and airplanes regardless of horsepower (I've chandelled an Aeronca); and that getting off the ground and back down again does not constitute flying.

He's going to have to be his own critic —to take nothing from himself but a good clean job of each on the following: 90, 180, and 360 spot landings (a spot is not ever 30 feet in diameter); chandelles; lazy eights; pylon, cross-road,, and down-road

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The Importance of Fittings

by RAOUL J. HOFFMAN

On the basis that a chain is no stronger than its weakest link, the fitting and structural connections of a plane are among the most important of all the myriad parts and yet are the most neglected.

IN a previous issue we brought you the strength values of various materials used in aircraft design and the estimation of simple stresses, stresses that are equally distributed over the cross-sectional area. These stresses are pure tension, compression (bearing) or shear, and are equal to the load divided by the area of the section.

Allowable loads that create stresses not easily evaluated are usually taken from tests conducted at various laboratories such as the U.S. Dept. of Agr., the Bureau of Standards, and others.

Charts showing the safe loads of heat-treated nickel-steel bolts in spruce beams parallel or vertical to the grain accompany this article. These charts are correct, within certain limits, when bushings are added to increase the bearing area without increasing the size of the bolt, and when the shear strength of the bolt is not below the bearing load indicated on the charts (Sec. 1).

Having obtained from the stress analysis all loads acting at a joint the designer should be able to produce safe and simple fitting with the aid of the charts.

Although a diversified knowledge be at command at the initial layout, a few fundamental principles will be of additional help.

It is desired that all main stresses be tension (or plain compression) equally distributed, and that all materials of connection (rivets, bolts, dowels) and all materials of adhesion (welding, brazing, soldering and glueing) to be in shear. No eccentricity should appear when loads are applied and that no stresses should be added when assembling.

Bolts that attach fittings to wood beams should be spaced to take their apportioned loads; this can be accomplished if other tests are not available by locating them conforming with the outline sketch in Sec. 2. The proximity of the bolts, as in Sec. 2, shows the principle of conservation of energy, that is, that the work done in causing a deformation of material will always be the minimum.

In order to prevent eccentricity the proper location of the bolts relative to the load line must be found by the methods of moments as illustrated by an example in Sec. 3. Draw a base line and lines through the center of bolts parallel to the line of the main load; then the sum of all moments (load times distance) divided by the sum of all loads gives the distance where the main load should pass.

An example of eccentric loading is the special shank designed to take two control cables. This fitting will break, for both cables cannot be made to have the same tension. A variation shown in the lower sketch of Sec. 4 or the use of two turnbuckles will eliminate eccentricity.

To obtain concentricity we join all loads and all neutral axes (gravity lines of members) at a common point (Sec. 5).

But not all centric forces result in a well designed fitting especially if they create bending stresses (see Sec. 6); then a reduction of the distance to the fastening will improve the design if the bending radius is at least equal to the thickness of the material.

Welding plays a big part in production of fittings, for complicated fittings can be made at low cost.

The cross-sectional area for estimating the strength of the weld should be taken at the throat of the weld and not at its contact with the material. To reduce residual stresses we weld from the outside towards the center; and if possible, we do not use circumferential welds.

We find, in Sec. 7 a few examples of welded lugs, in Sec. 8 various tube connections with their approximate efficiencies and at the lower part a tube connection with rosette weld and rivet weld. Rosette weld, which is welding of drilled holes, should not be employed; rivet weld, which is inserting rivets into drilled holes and welding their ends, is of poor appearance but it is easily disassembled by filing off the welded part of the rivet.

In Sec. 9 we find tube and fittings with lugs or bearings, their selection depending on the load to be transmitted. In order to have the unit aligned the tubing used for the bearing is trimmed after welding.

Universals shown in Sec. 10 are used for two-way motions; a heat-treated tubing, a few thousandths longer than the hole, will make a satisfactory shaft if the oscillating part is bolted securely.

Designs of hinges for control surfaces are shown in Sec. 11 and Sec. 11A; in case clamping pressure is too high for the spruce beam a three-ply wood piece or a sheet steel base may be used.

A multitude of fittings could be designed for fuselage joints; some are shown in Secs. 13, 14, 15, and 16. Simple control levers are illustrated in Sec. 11A and Sec. 15.

Wing fittings usually give the engineer ample opportunity to show his talent of simplifying the design and his ability to conceal it within the wing itself. Wing fittings from the old pusher type to the latest all-metal biplanes are shown in Secs. 17, 18, 19 and 20.

Special problems confront the builder of landing gear fittings, especially if the landing gear is to be retracted. One question of importance is whether the axle is to be heat-treated or not, and if it is to be heat-treated before or after the welding. In case the axle is heat-treated separately, all parts are welded to a sleeve, the axle placed into the sleeve and welded at one end as shown in Sec. 21.

Use of universals in landing gears, see Sec. 22, is for the prevention of damage to the main structure of the fuselage by folding back in case of accident; thus reducing the cost of repair.

Landing-gear fittings usually mean hinge designs. Sec. 23 shows the main principle of the coordination of all hinge axes. If the axle is fastened to a V-ee then all axes must be parallel to A-A-A; even if fitting

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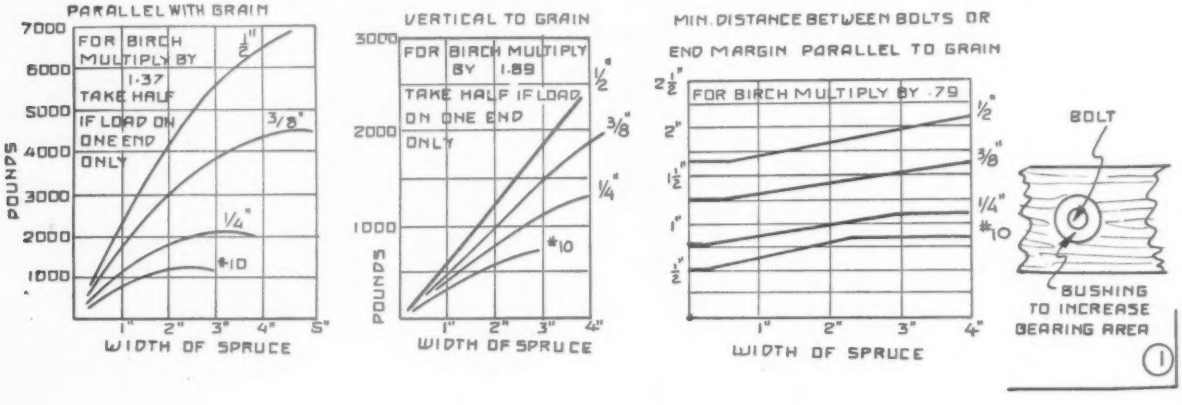
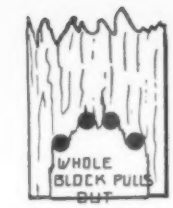
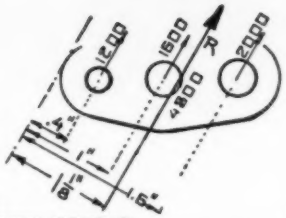

PARALLEL WITH GRAIN
FOR BIRCH MULTIPLY BY 1.37
TAKE HALF IF LOAD ON ONE END ONLY
POUNDS
WIDTH OF SPRUCE
VERTICAL TO GRAIN
FOR BIRCH MULTIPLY BY 1.89
TAKE HALF IF LOAD ON ONE END ONLY
POUNDS
WIDTH OF SPRUCE
MIN. DISTANCE BETWEEN BOLTS OR END MARGIN PARALLEL TO GRAIN
FOR BIRCH MULTIPLY BY .79
WIDTH OF SPRUCE
BOLT
BUSHING TO INCREASE BEARING AREA



EFFECT OF TOO CLOSELY SPACED BOLTS

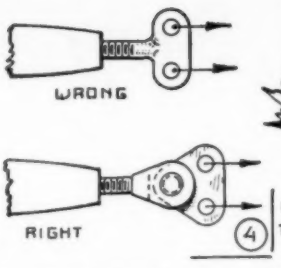
LAY-OUT FOR BOLTS

(2)



TOTAL MOMENT:
.4×1200+1×1600+1.6×2000=5280
DISTANCE of R=5280/4800=1⅛"

(3)



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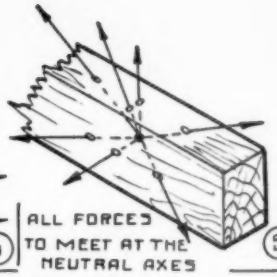
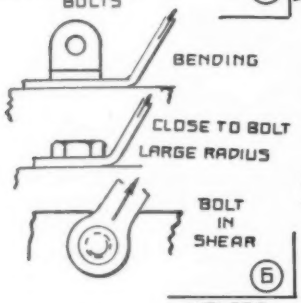


ALL FORCES TO MEET AT THE NEUTRAL AXES

(5)



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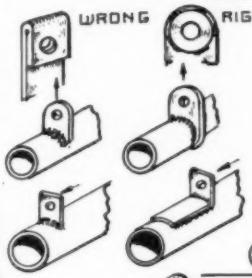

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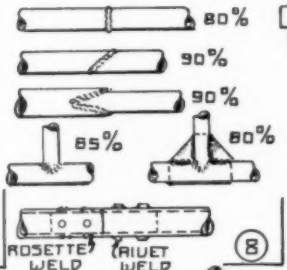

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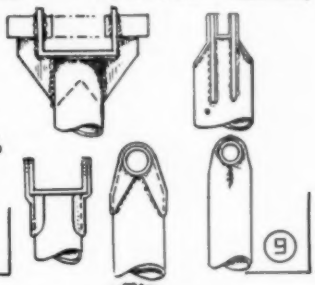

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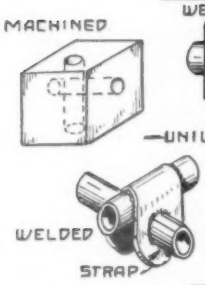

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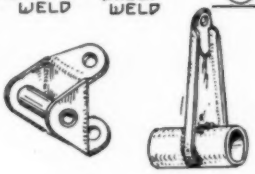
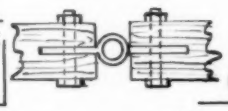


CONTROL SURFACE HINGES

(11)



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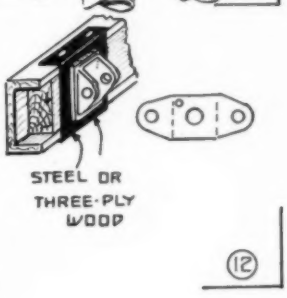

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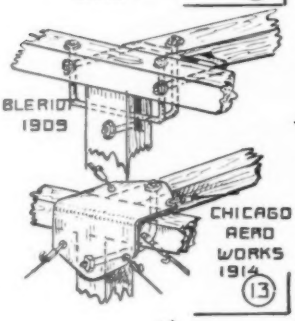

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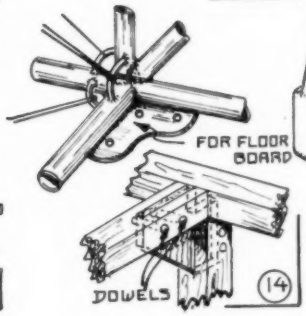

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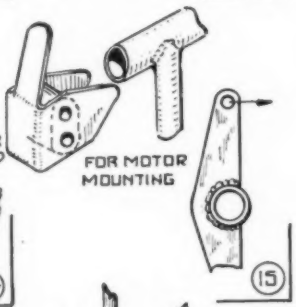

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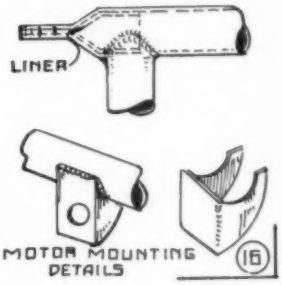

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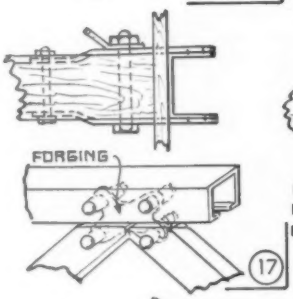

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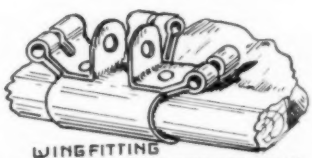
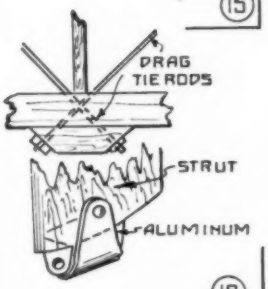


WING FITTING MADE OF ONE PIECE OF SHEET METAL. FASTENED TO LEADING EDGE (FRONT BEAM) 1914

(18)



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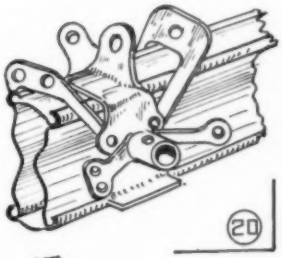

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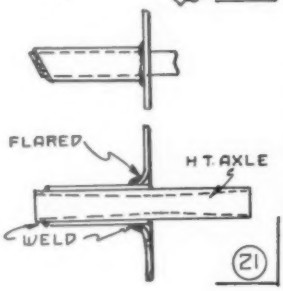
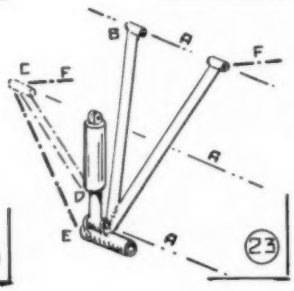


(21)

UNIVERSAL FOR LANDING GEAR TO PREVENT DAMAGE TO FUSELAGE

(22)



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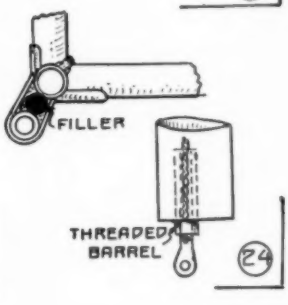


(24)

A Gas Powered Aero-Sled

by DICK COLE

PART II

Here we have the second article dealing with the construction of a high-speed motor sled with the dimensioned assembly drawing of the complete sled.

AND now we have progressed to the point where we can analyze the assembly elevations of the motor sled which show accurately the relations existing between the various units and elements entering into the layout.

Our first problem will be to check up from the general drawings with a view of accommodating the engine which happens to be available in your particular case. It is understood, of course, that the greater the power output of the engine, the faster it can swing the propeller, the higher can be the pitch and the faster the sled can travel.

Almost any auto engine, in good condition and developing more than 30 actual horsepower can be used, but undoubtedly a very much improved performance can be had with a power-plant giving from 50 to 60 actual horsepower and an engine of this output is most certainly advised. Model "T" Ford engines are ruled out, first because they are likely to be so old and worn that they cannot develop the necessary power and, second, because they are more difficult to convert than other types.

For those who have a racing turn of mind, with ultra speeds in view, it will be necessary to convert the engine to this job in much the same way that auto engines are converted for driving light planes, but possibly not to the same extent. We must have unusually good carburetion, good compression and unfailing ignition to develop the latent possibilities of this craft. Of course, we can simply transfer the engine from the auto to the sled, making the few necessary corrections, but this is not sufficient for the majority of our red-blooded readers.

And then comes the propeller which is a most important part of the power-plant and one that is not to be regarded lightly or carelessly. While such a propeller can be built at home without previous experience, yet the cost of a factory built prop is so low and its performance will be found so much better that it is highly advisable to buy the propeller from a firm specializing in this work.

All of the power developed by the engine is transmitted to the air through the propeller, and it therefore makes a lot of difference whether the efficiency of the propeller is 60 per cent. or 80 per cent. And, no matter what revision you may make to this design, never under any conditions reduce the propeller diameter below the dimensions shown on the drawing. Pitch is largely a matter of engine speed but diameter represents the ability to transfer power to the air without excessive slipping or cavitation.

Mr. Cole, in his home workshop, shows how the runner of the power-sled is made and assembled.

A very efficient type of propeller drive has been devised which is very nearly as efficient as a direct drive if it is carefully installed and lined up. This is a multiple strand "Vee" belt running in grooved pulleys which has ample driving ability, quiet running characteristics and flexibility to recommend it. It is far superior to the older type chain and sprocket type drive in every essential respect. Bureau of Air Commerce tests show that the efficiency of this drive hovers around the 90 per cent. mark.

These preliminaries regarding the power-plant are mentioned at this point because they are more or less the foundation around which we build the rest of the structure, and before we begin to work the power-plant problem must be definitely settled. Even though you are not yet in a position to take possession of the engine, the proper engine should be easily available so that the dimensions can be measured off.

Good materials for the chassis are our next consideration, and while either spruce or ash can be used, yet the preference lies with ash because of its greater springiness and toughness. The slight difference between the weight of the ash and the spruce, while important with aircraft, is not prohibitive with a power driven sled of the type described here.

Where ash is not easily obtainable, rock elm is a possible substitute, always providing that the elm is given a deep penetrating coat of hot linseed oil as a protection against warping. After the oil has dried, three finishing coats of paint or spar varnish can be added.

For those who have not had much experience in this sort of wood-working, it will be well for them to pay particular attention to the bolt holes drilled in wood. As wood has but little strength in bearing and has the unfortunate habit of shrinking around a bored hole, it will be found advisable to "caseharden" the wood at this point by the following method.

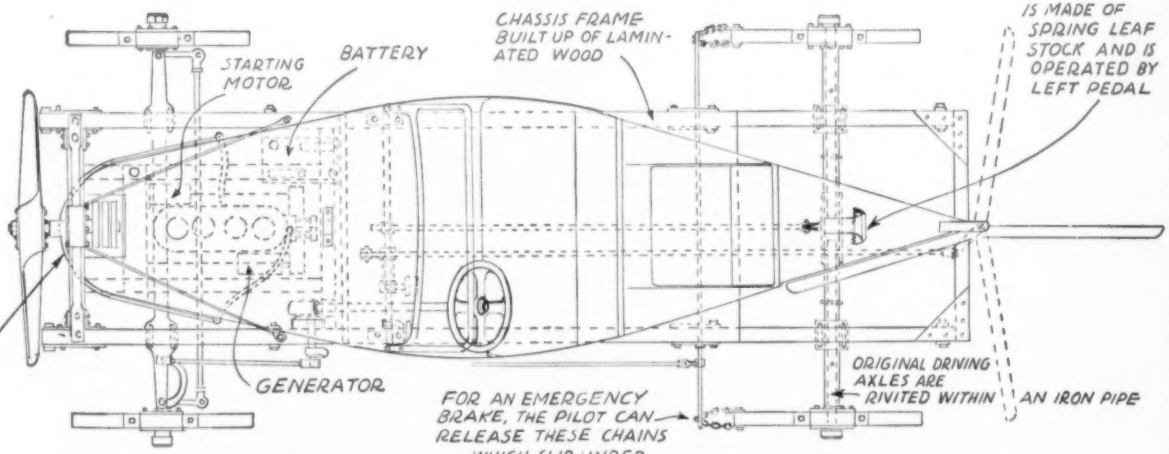
First, drill the hole about 1/16-inch smaller than the required bolt. Then, take one of the bolts or a rod of the same diameter, heat it red hot, and then force it through the hole, searing the wood and hardening the surface all around the bore. When prepared in this way, the bolts will stay put and will not loosen.

Washers should be placed under all nuts and bolt heads where the bearing is on wood, and important nuts should be safetied by using castle nuts and cotter pins to prevent the nuts from backing off. Where castle nuts cannot be obtained, lock-washers are a possible but not entirely satisfactory substitute.

XUM

PLATE 1

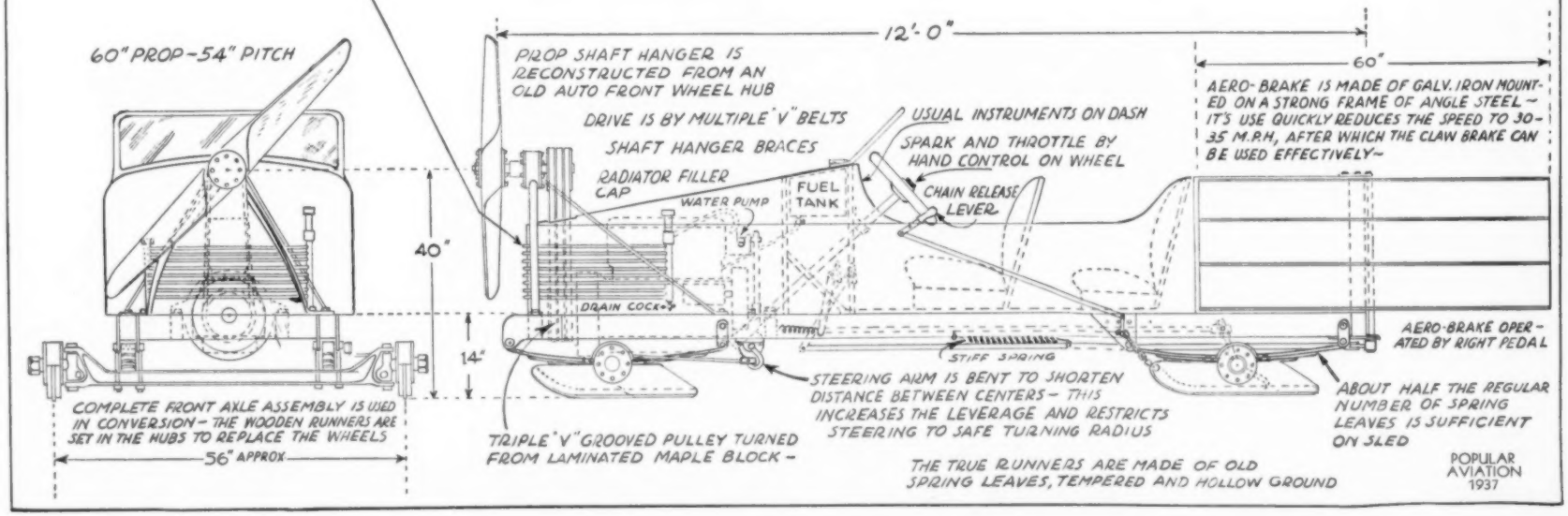
Here is a comparatively safe 100 M.P.H. ice vehicle. In spite of its seeming complexity, the construction is entirely within the scope of the home mechanic with ordinary workshop facilities. The fundamental requisite is an old four or six cylinder light-car with the motor in reasonably good mechanical condition. Drive from the motor to the propeller shaft is through a "vee" belt drive.


STARTING MOTOR
BATTERY
CHASSIS FRAME BUILT UP OF LAMINATED WOOD
CLAW BRAKE IS MADE OF SPRING LEAF STOCK AND IS OPERATED BY LEFT PEDAL
GENERATOR
ORIGINAL DRIVING AXLES ARE RIVITED WITHIN AN IRON PIPE
FOR AN EMERGENCY BRAKE, THE PILOT CAN RELEASE THESE CHAINS WHICH SLIP UNDER THE RUNNERS

LENGTHS OF 3/8" COPPER TUBING SHAPED AROUND NOSE SERVES AS A VERY SATISFACTORY RADIATOR

BOTH RUNNERS REPLACE WHEELS BETWEEN THE ORIGINAL WHEEL HUB FLANGES – BEARINGS USED ON FRONT RUNNERS

REAR RUNNER HUB IS FITTED TO DRIVING AXLE WITHOUT KEY, SO RUNNER IS FREE TO OSCILLATE


12'-0"
60" PROP-54" PITCH
PROP SHAFT HANGER IS RECONSTRUCTED FROM AN OLD AUTO FRONT WHEEL HUB
DRIVE IS BY MULTIPLE "V" BELTS
SHAFT HANGER BRACES
USUAL INSTRUMENTS ON DASH
SPARK AND THROTTLE BY HAND CONTROL ON WHEEL
RADIATOR FILLER CAP
WATER PUMP
FUEL TANK
CHAIN RELEASE LEVER
60"
AERO-BRAKE IS MADE OF GALV. IRON MOUNTED ON A STRONG FRAME OF ANGLE STEEL – IT'S USE QUICKLY REDUCES THE SPEED TO 30-35 M.P.H, AFTER WHICH THE CLAW BRAKE CAN BE USED EFFECTIVELY–
40"
DRAIN COCK
14"
AERO-BRAKE OPERATED BY RIGHT PEDAL
STIFF SPRING
STEERING ARM IS BENT TO SHORTEN DISTANCE BETWEEN CENTERS – THIS INCREASES THE LEVERAGE AND RESTRICTS STEERING TO SAFE TURNING RADIUS
ABOUT HALF THE REGULAR NUMBER OF SPRING LEAVES IS SUFFICIENT ON SLED
COMPLETE FRONT AXLE ASSEMBLY IS USED IN CONVERSION – THE WOODEN RUNNERS ARE SET IN THE HUBS TO REPLACE THE WHEELS
56" APPROX
TRIPLE "V" GROOVED PULLEY TURNED FROM LAMINATED MAPLE BLOCK –
THE TRUE RUNNERS ARE MADE OF OLD SPRING LEAVES, TEMPERED AND HOLLOW GROUND

POPULAR AVIATION 1937

Designing Lightplane Controls

by HAROLD GIBBONS

A simple but useful discussion of aileron design for the attention of the amateur and home-builder. The various types of ailerons and their relative effectiveness are covered.

IN view of the importance of properly designing the control surfaces of a lightplane, I have set forth all of the facts regarding control surface design that the beginner may arrive at a proper design without employing complicated figures, etc.

No matter what type of a control surface is used to produce a required force or moment, the effort required on the part of the pilot to operate that control surface must be a minimum. This is the one outstanding point that we must work to in proportioning the surfaces.

There are no fixed rules governing the design of these surfaces. The only way to make a decision as to what size and type of surface should be used is to make a series of tests in a wind tunnel on different sizes and types of model surfaces on the same model plane.

Since most amateurs cannot make or have made, these tests, they must use certain relative proportions taken on a wide average of several existing types of successful lightplanes in designing the control surfaces for their lightplane.

Considering the ailerons, there are many outside factors which are influential in their design. Getting down to facts:

There are four types of wing tips in general use, namely: the square, negatively and positively raked tips, and the elliptical.

In Fig. 1 is shown the pressure distribution on the four general types of wing tips taken from tests made by the N.A.C.A. It is obvious that the square and positively raked tips are undesirable shapes as the pressure distribution is irregular and high concentrated loads are present at the wing tips.

This complicates the design of the ailerons as well as calling for a heavy structure. Wing flutter with the possibility of undue wear on the aileron hinges may exist which is extremely dangerous at high speeds.

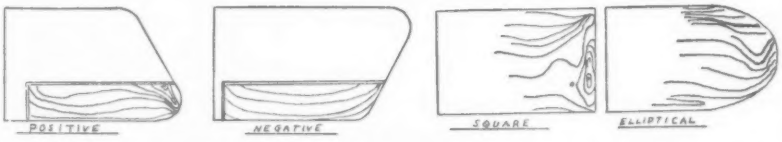


Fig. 1. Showing the air pressure distribution over four types of wing-tips, a matter of importance in the design of ailerons and other controls.

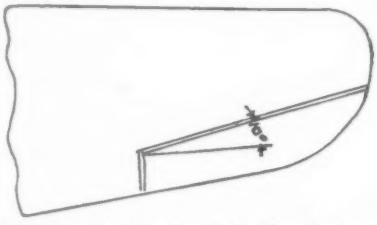


Fig. 2. A skew type aileron hinged at an angle of 20-degrees with the spar.

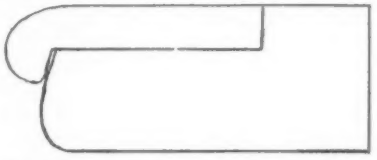


Fig. 3. An overhung type of balanced aileron extensively employed on German planes during the war.

The negatively raked tip is undoubtedly the best tip as the pressure distribution is more uniform. The elliptical tip is almost as good and offers somewhat better aileron control.

The planform of the aileron is of utmost importance from both an aerodynamical and structural standpoint. The aspect ratio could be placed under planform.

The aspect ratio of the ailerons should never be lower than six nor higher than eight. If the aspect ratio is lower than six the drag of the aileron is excessive in operation as well as a general weakness being present in the wing tip.

On the other hand, if the aileron has an aspect ratio above eight the rolling moments will, in most cases, be too low. In planes of unusual span a higher aspect may be used in order to keep the c.p. of the aileron at the proper distance from the c.g. along the lateral axis to obtain the proper rolling moments.

Again, the chord of the aileron should never be less than 15 percent nor more than 25 percent of the chord of the wing at that section, which means that such an aileron would be structurally weak.

Tests made by the British N.P.L. showed that the chord of the aileron should be 25 percent of the wing chord and the span one-fourth of the span. This applies to rectangular wings employing thin airfoils.

In Fig. 2 the aileron has been given an angle of "skew." The use of skew greatly improves the efficiency of the aileron. In tapered wings it should always be used both from an aerodynamic and structural viewpoint. If an aileron in a tapered wing is not given this angle, the rolling moments are not sufficient at high angles of attack.

If too much skew is used the condition is reversed. It is very desirable to use skew on rectangular wings. (This angle should never be more than 10 degrees in any case.) Its chief drawback is that it offers certain building complications for the beginner.

The area of the ailerons depends upon the wing section used and the wing planform. For wings that are relatively thin, it has been found that from 12.5 percent to 15 percent of the total wing area is sufficient. If the wing is tapered, 10 percent is usually sufficient.

In this case, or in any tapered airfoil for that matter, the ailerons are more effective if they are narrow, the chord being from 15 to 20 percent of the wing chord. They are even more effective when used in wings that are tapered in planform or thickness *only*.

In biplanes the ailerons are more effective on the top wing in the air and on the bottom on the ground if positive overhang is used. In order to get a compromise, many designers place ailerons in both wings, distributing the area according to the wing area percentages.

For example: if a biplane has the area so divided that the upper wing area is 60 percent of the total area, then the ailerons in the upper wing will have 60 percent of the total aileron area. Tests have been made showing that if single ailerons are used with positive stagger and on wings of equal chord and span, they are more effective in the lower wing. On small biplanes the ailerons are usually placed in the lower wing to offer a simple control connection.

(*Concluded on page 73*)

Fig. 4.

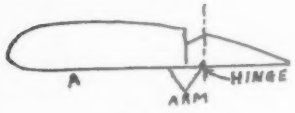


Fig. 5A.

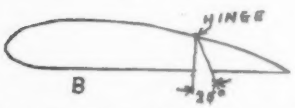


Fig. 5B. The aileron is hinged at the upper surface with the 20-degree gap below.

Building Howard's Cabin Job

by
PAUL W. LINDBERG

Model airplane designer and Model Editor for POPULAR AVIATION.

You will be proud of the lifelike appearance and the fine flying performance of this Howard monoplane.

THIS fine flying model is an exact duplicate of the plane now in production by Benny Howard and his associates. This model is a very good flyer and we are sure you will enjoy many interesting hours building it.

COLOR SCHEME

Fuselage—orange and black with white trim.

Wings and tail surfaces—orange with black and white trim.

Details—silver, black and white.

CONSTRUCTION OF FUSELAGE

In order to prevent the framework from sticking to the plan, we advise you to use a sheet of ordinary wax paper between the framework and on top of the plan.

We suggest that you begin with the fuselage, which is constructed one side at a time. The longerons, vertical and diagonal, etc., are held in place until securely cemented. This is done by inserting straight pins on either side of the strips.

When the fuselage sides are completed, they are pinned to the top of the plan in such a manner that the top longerons face down and the sides are at right angles with the table. The cross members are now cemented in their places forming a rectangular fuselage.

Cut formers from sheet balsa and cement in their respective position. There are only a few of these formers attached to the fuselage and little difficulty will be encountered here. Refer to plan for exact sizes.

The position of stringers is clearly shown on formers. Note: All stringers pass over tops of each former. This results in a neater covering job.

CONSTRUCTION OF THE WINGS

This wing is made up of two separate panels. Cut all ribs from 1/16" balsa. Pin the spar in position on the plan. Now, cement the ribs in their proper locations.

The leading and trailing edges are cut and sanded to shape then cemented to the ribs. The panels carry removable ailerons, which are a great help in controlling the flights.

Make wing tips from 1/16" balsa. We highly approve of this type wing tip because it is much easier to construct and neater in appearance.

CONSTRUCTION OF ELEVATOR AND RUDDER

These are made from 1/16" square flat balsa and are constructed on the plan. Their construction is easy—therefore, you should have no difficulty here.

In covering the elevator it is important that the two units are covered separately in order that they may be inserted in slot at rear of fuselage. The aluminum hinges are inserted after they have been placed in the rear of the fuselage.

CONSTRUCTION OF LANDING GEAR

The construction of the landing gear struts is clearly shown on the plans. These struts are constructed of tough balsa and are reinforced with wire stiffeners. Balsa or paper fillets are used for fairings.

CONSTRUCTION OF THE MOTOR

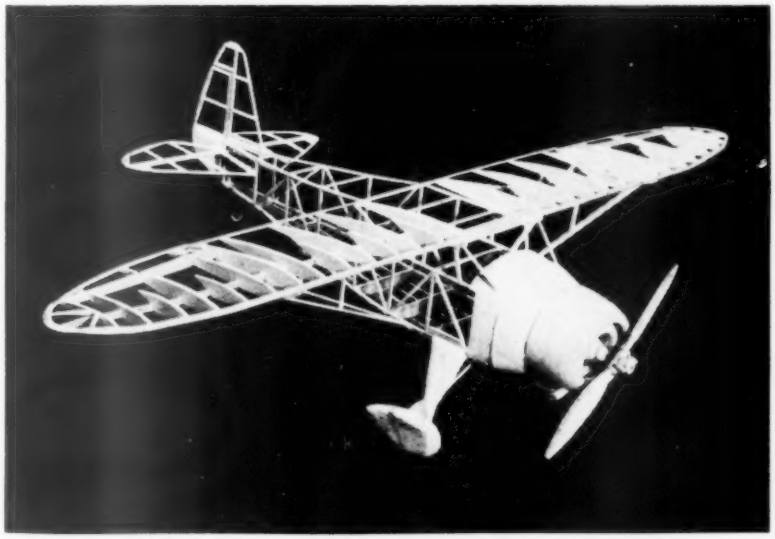
The crank case is built up from solid blocks of balsa, the cylinders of solid balsa, wrapped with heavy thread to imitate fins. Push rods, rocker arm caps, etc., are clearly explained on plan.

ASSEMBLY

The landing gear is now attached to the fuselage. It is very important that these parts are securely fastened, in order that it may survive severe landings.

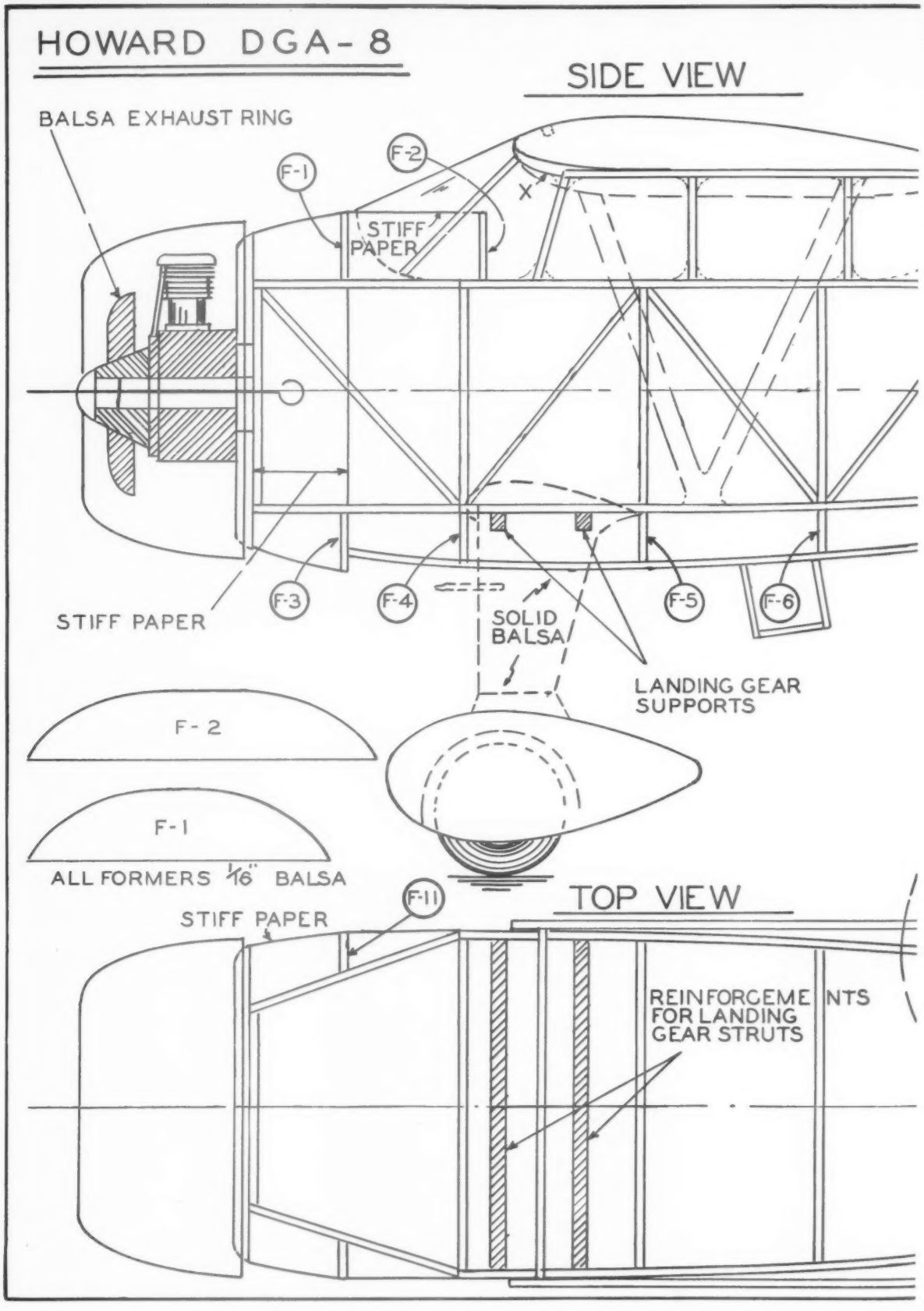
Attach the wing panels to the top of fuselage cabin by merely cementing them in place. The wing struts are now attached and as you will note the upper part is neatly faired in with an extra rib and paper fillet.

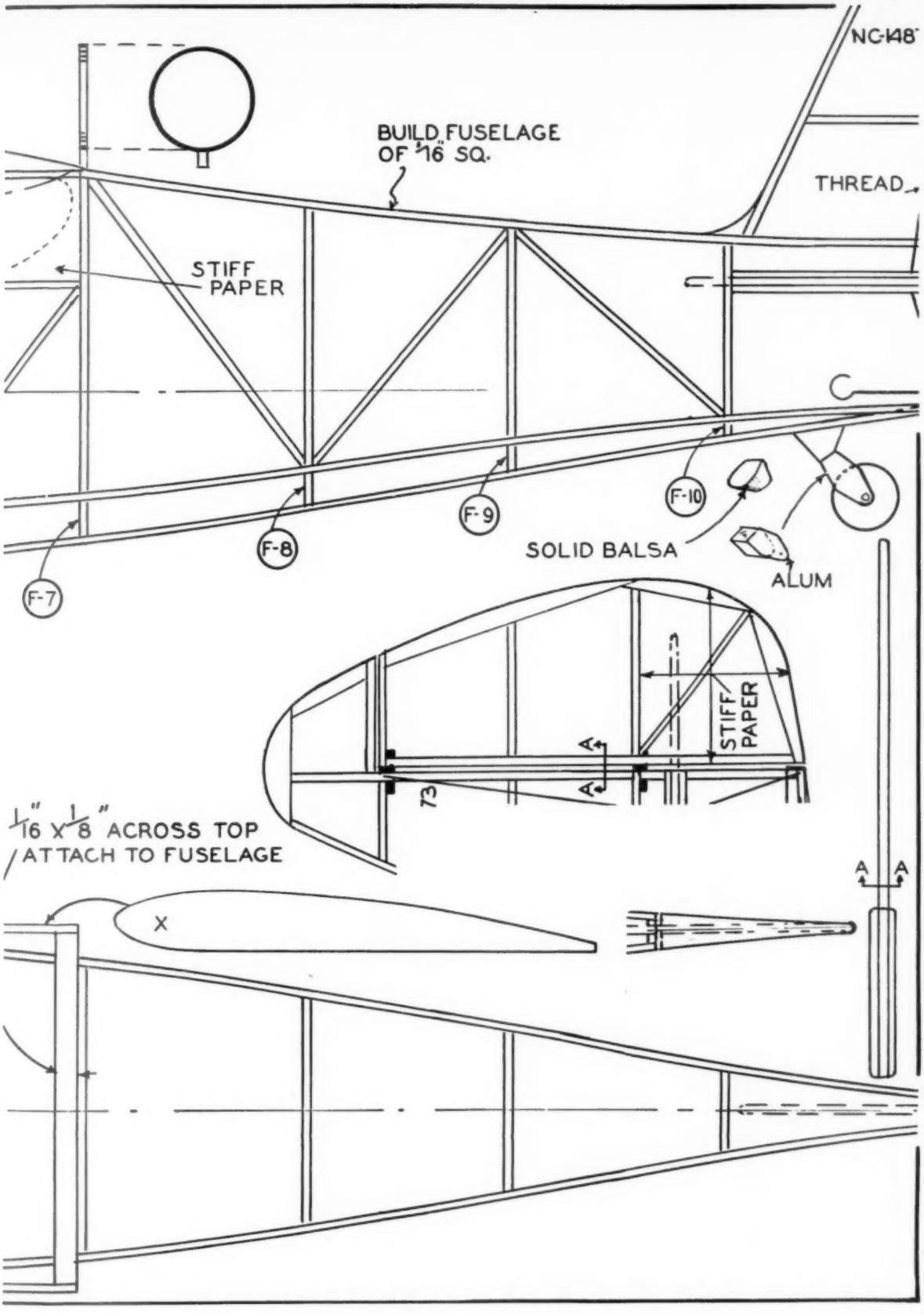
(*Concluded on page* 70)

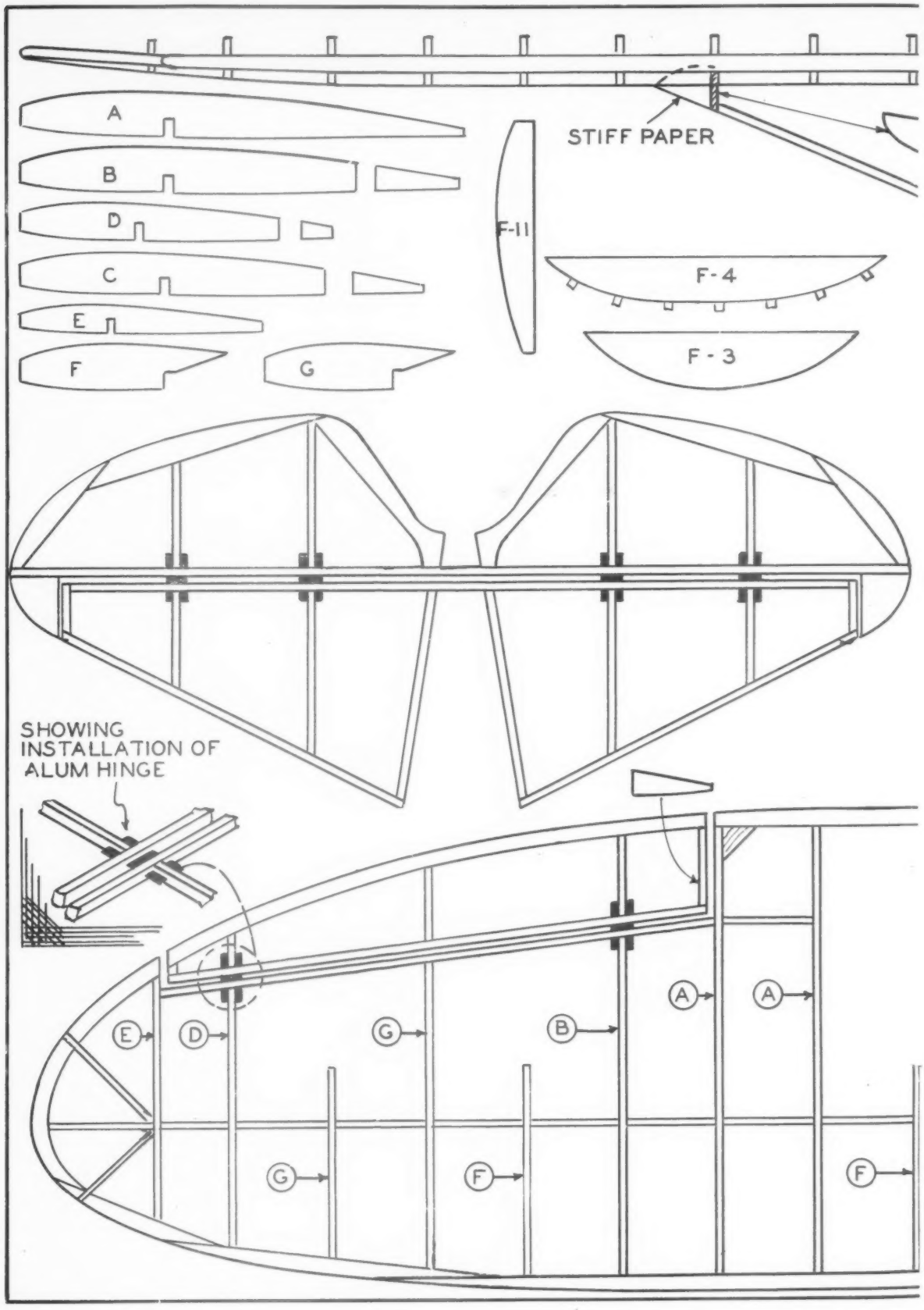


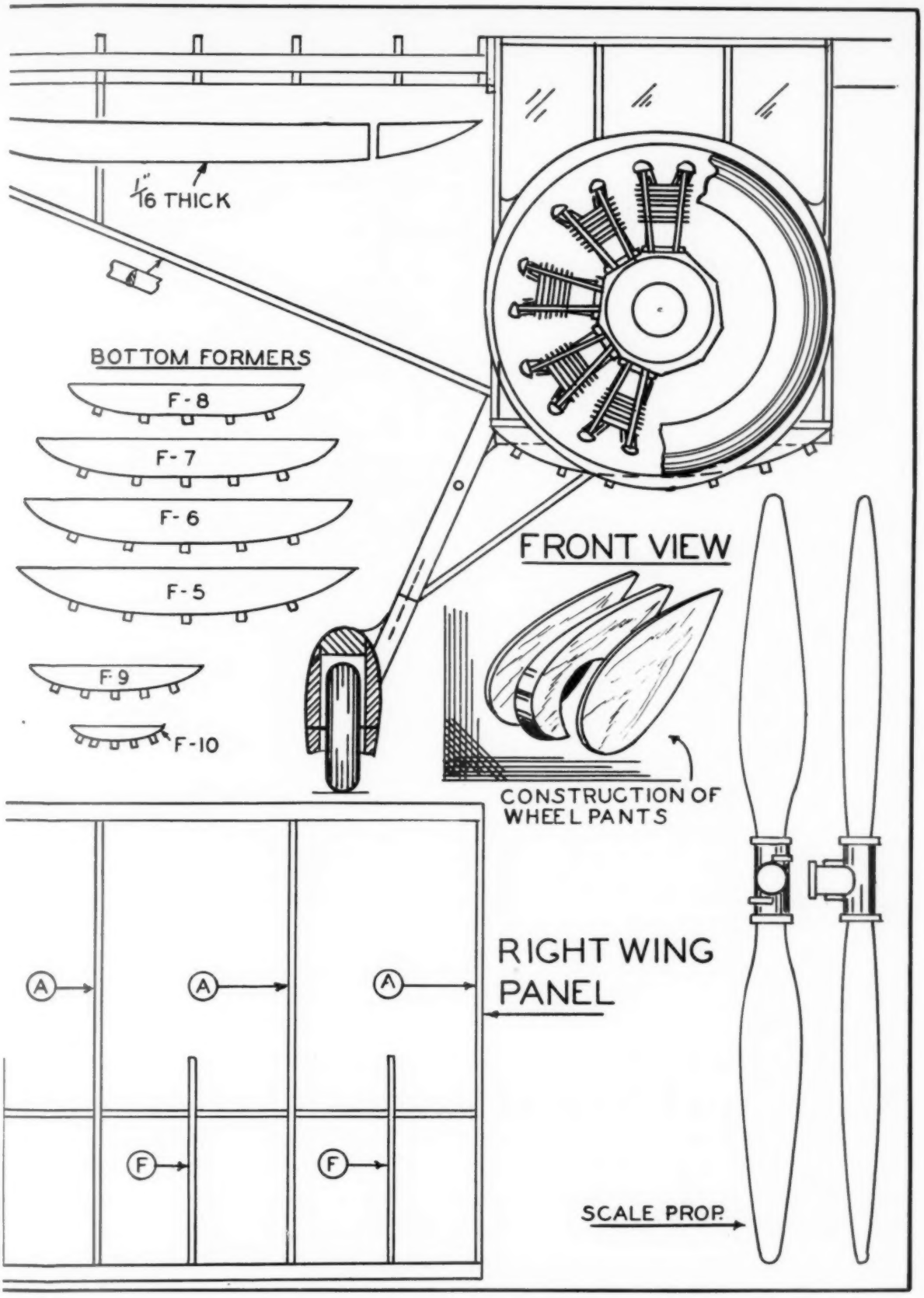
The skeleton of the Howard cabin plane before covering is applied.

XUM


HOWARD DGA-8
SIDE VIEW
BALSA EXHAUST RING
F-1
F-2
X
STIFF PAPER
STIFF PAPER
F-3
F-4
SOLID BALSA
F-5
F-6
LANDING GEAR SUPPORTS
F-2
F-1
ALL FORMERS 1/16" BALSA
F-11
STIFF PAPER
TOP VIEW
REINFORCEMENTS FOR LANDING GEAR STRUTS


NC-148
BUILD FUSELAGE OF 1/16 SQ.
THREAD
STIFF PAPER
F-7
F-8
F-9
F-10
SOLID BALSA
ALUM
STIFF PAPER
A
A
73
1/16 X 1/8 ACROSS TOP
ATTACH TO FUSELAGE
X
A A


A
B
D
C
E
F
G
F-11
STIFF PAPER
F-4
F-3
SHOWING
INSTALLATION OF
ALUM HINGE
E
D
G
B
A
A
G
F
F


1/16 THICK
BOTTOM FORMERS
F-8
F-7
F-6
F-5
F-9
F-10
FRONT VIEW
CONSTRUCTION OF WHEEL PANTS
A
A
A
F
F
RIGHT WING PANEL
SCALE PROP.

Bellanca

(*Continued from page* 18)

scientists have of rocket engineering I believe it is possible to construct such a ship. Of course, I have no reference to such rocket ships as Buck Rogers uses in his fantastic interplanetary adventures in the syndicated newspaper strips. I find it even difficult to visualize a ship without wings.

"What I can see for the future is a stratosphere ship with a combination of rocket propulsion and motorized propellers. The propellers would give the ship greater control in the atmosphere and the rocket power would give it greater speed in the stratosphere."

Q. Of what materials will the super planes of tomorrow be made?

A. "Tomorrow's planes will be made of light weight metal unless some radical new composition material is discovered. The new metal, berillium, may be extensively used in the future, for a new inexpensive method has been discovered to produce it in quantities.

"Then there is the discovery of a new method of treating wood, moulding it into the desired shape for airplane use under heat and pressure. Tests show that it is practically bullet proof and fire proof. It is estimated that a plane of this material can be built for one dollar per pound. This material may have a revolutionary effect on future aviation.

Q. Do you think that the airplane by its shortening of distances will tend to unite the world and make for peace or that the nations of the world will use them as murdering tools to destroy each other?

A. "I believe that the airplane will do more to promote world peace than any other one thing existing today. It will do more than politicians, more than ambassadors, more than any peace or disarmament conferences could possibly do. That is, it will accomplish this seemingly impossible task if the nations are not forced into war before the world has been completely linked by airlines.

"I make this statement after studying what the railroad did for the United States. If the railroad had not come when it did, Americans today might, figuratively, be speaking forty-nine different languages. The railroad served to eliminate distance and link the states together at a crucial time. Today we are one."

END

Penaud

(*Continued from page* 34)

plated by his "turning up" of the trailing edge "during flight." And here is his full cantilever wing and his conception of a "stressed skin."

"We reserve, in the case the surface of the wings should be of veneer or even of metal, making the surfaces themselves the frame piece of the wings, giving to the fibres of these strips of veneer or of metal, a direction running from the car to the end of the wings; these lower and upper surfaces would be stayed together, from point to point, from the base of the wing to its extremity by pieces placed edgewise and parallel to the plane of symmetry." (Penaud also provided for a dihedral angle on the outer fourth of the wings to promote stability.)

It is not apparent that Penaud understood the thick wing section. The model which he built employed this section and actually left the ground in a wind of nine miles an hour, so that the thick section must have been effective. It is easy to believe that he would soon have discovered and applied the principle of the thick wing and the vacuum lift.

"We employ two equal propellers located at the front of the sustaining surfaces and close to the sides of the apparatus . . . We reserve causing these axes to make with this surface an angle capable of running up to five degrees . . . We reserve placing the axes of these propellers either in the median plane of the wings, or preferably at a short distance under this plane.

"This position of the line of traction of these propellers is important for the fore and aft equilibrium, the line of traction of these propellers being obliged to pass almost through the centre of resistance to the course, and through the centre of gravity . . . they are of opposite pitch and rotate in opposite directions.

"We reserve making them rotate either independently one of the other, or integrally . . . By giving the diameter of the propellers a twelfth of the spread of the sustaining plane, we are almost in the best conditions.

"The propellers are entirely metallic and preferably of steel . . . These propellers can have from two to twelve blades . . . We reserve applying to the propulsive propellers of our aeroplane any one whatever of the numerous systems of changing pitch during running, known and used in marine practice.

"This change of pitch will permit of turning the blades so as to offer only little resistance to the forward movement when the propellers shall not rotate; it permits also of assisting the starting by the previous storing-up of a great amount of energy in the blades; we shall thus apply to the aeroplane a theory already known for ascensional propellers of apparatus in a different class, known as helicopters.

"Note the use of a single engine, or of two engines placed within the body of the apparatus and transmitting rotation to the propellers, either by means of supplemental shafts and gearings, or by belts or cords and pulleys, or by endless chains and toothed wheels, or by endless steel sheets and pulleys, with or without teeth, or by pieces of shafting connected together by universal cardan joints, or by pieces of shafting connected by flexible connections of steel or other elastic substance."

And here Penaud came up against the problem of power. He had no satisfactory engine. His specifications mentioned every one that he considered suitable, but he seemed to prefer such internal combustion engines as those of Hock, Lambugel, etc. With an engine of proper power and lightness, it is a virtual certainty that his plane would have flown. He made provisions to have all power plants within the body of the plane, within reach of the mechanician and pilot. The surface of the nacelle, or any or all parts of the surfaces of the wings were to be used for cooling or condensation.

Four longerons comprised the basis of the construction of the entire aeroplane, and were the framework of the nacelle. Two weaker longerons supported the flooring of the car. The wings and control surfaces were attached directly to these main longerons which were braced according to current knowledge of bridge building, due regard being taken to keep the space for passengers and pilot unobstructed. The nacelle was water-tight and glass portholes were provided. Entrance was attained through a side door, or through a manhole near the pilot's post.

"In the high-speed apparatus, there will be no rope bands and the nacelle may have, especially at the front, sections rounded off, like those of the body of a bird, instead of quadrangular sections; the membrane of the nacelle could then be a little different.

"The pilot can be seated or standing. His head projects above the front of the nacelle, and is kept from contact with the air either by a mask with glass eyes, or by a glass plate placed in front of him. His head can also be sheltered in a small chamber flush with the nacelle and arranged so as to cause the least possible resistance to the air."

Penaud planned a Dep control, perhaps the first. A vertical bar on which was fixed a sort of handle bar, managed all the controls. By pushing the whole thing forward, the elevators were depressed, and by twisting it to right or left, the directional rudder was moved. All controls and connections were enclosed within the nacelle adding greatly to the clean appearance of the plane.

And now for the automatic pilot of 1876:

(*Concluded on page* 54)

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America's Greatest National Air Show!
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JACKSONVILLE, FLA., Feb. 14—DAYTONA BEACH, Feb. 28, 1937

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When you're way upstairs and the going gets thick—when there's a sudden need for an out-of-the-routine job—whenever the unexpected happens—that's when you need the extra performance that is the mark of a truly great plane.
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SIKORSKY AIRLINERS
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Penaud

(*Continued from page 52*)

"Besides the view over the horizon of the indicating lever, the pilot has before his eyes, to guide him in the perception of the dip of the apparatus, a level of any system whatever. If the level adopted is a water level, one of the bottles, provided with a gauge, will be before the pilot, while the other will be toward the rear in the nacelle.

"The two bottles will be in communication by a tube provided at one of its points with a throttling device variable in such a manner as to attain the proper sensitiveness. The front bottle can be replaced by a very sensitive manometer in communication with the column of water.

"The aeroplane is provided with a compass and a metallic barometer. The vertical rudder can obey, by means of an automatic electrical apparatus, the indications of the magnetized needle oscillating between two metallic stops; in this way, the routes of the apparatus will be automatically maintained.

"The horizontal rudders can be worked by automatic electric mechanism obeying the indications of the level and of the barometer, so as to obtain a flight perfectly horizontal. These mechanisms could also act upon the speed of the engine."

His tendency to continual study and experimentation found expression in a device for determining the pressure at various parts of the plane while in flight. He visioned "pressure testers" to consist of light planes parallel to the wings and mounted on springs, or the use of manometric tubes opening onto the lower face of the wings. All such apparatus, he mentioned, can be provided with an electric alarm. "Anometres will indicate the speed of the aeroplane in the surrounding air. Vanes of dip can also be present."

Three methods of launching the plane were described. "The apparatus can be launched on its start by powerful springs, or be placed upon a car rapidly moved by steam or other engine." Or, the plane would be driven along the ground, especially leveled, by its own propellers—"When a sufficient speed has been thus attained, the air which acts upon the lower face of the sustaining plane, raises the apparatus progressively above the ground, and the flight commences." From this it appears that Penaud was not sure of the purpose of his thick wing.

On the water, the plane would take off in the usual manner of seaplanes, "or upon the metallic inclined planes carried under the nacelle by means of rigid rods." These planes—we call them steps—were to be retractable.

Of his control surfaces, Penaud says:

"We reserve balancing, as regards the weight, the rudders with horizontal hinges, which we call also our horizontal rudders. This balancing about their hinges allows these rudders to set themselves in the wake of the air, when they cease to be operated by the pilot. This balancing is obtained by means of counterweights or better, of springs acting suitably upon these rudders.

"The effect of balancing takes place naturally for the vertical rudder, especially if there is a little rake." All his control surfaces were compensated, "presenting a fixity of position noticeable under the effect of air eddies." He understood perfectly the functions of the fixed vertical stabilizer—a valuable lesson which hundreds who followed him failed to learn.

He provided that the horizontal rudders be operated together or separately, another indication that he had some conception of the aileron.

"The horizontal rudders are simply working rudders serving to ascend and descend, stable equilibrium being obtained, as we have already said, in a permanent manner by turning up of the rear border of the sustaining plane."

Landing-gear to Penaud consisted of "feet." He described his particular method in great detail and clarity, and used the simplest of examples to describe the retracting feature:

"The front feet can be housed in the general shapes of the nacelle by a mechanism clearly developed in our drawings, and by a movement like that of a man, who, having at first his hands as if to strongly push a door in front of him, should then cross them upon his chest. Hollows in the surface of the nacelle receive the different pieces of these feet." He also provided for movable plates to close these hollows when the wheels were retracted.

The rear wheels were on either side of the nacelle, and were set in forks at the end of rods which were dog-leg in shape. As these were retracted, to the rear and

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Remove the core from the plug and place it with its firing tip 3/16" away from a grounded point. The spark is jumped across this 3/16" gap, either coil or magneto being used as the source of current. The test should be made at atmospheric pressure. If corona is present it can be seen as a streak of light *inside* the mica washers which form the core. It is obvious this leakage impairs the spark at the gap.

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into hollows in the nacelle, the elbow, or "shoe," of the crooked rod dragged on the ground after the wheel had been lifted clear of the ground. This formed a "violent" brake against forward movement.

For shock absorbers, Penaud planned to use the familiar carriage spring leaves. His drawings and specifications also showed the use of rubber cords, and in his specifications he said, "The hand rubber can be replaced by a steel spring or an air spring under the same conditions."

Ropes and chains passing over pulleys were to be used to retract the four wheels, which were fastened in up or down positions by bolts. For the "simultaneous and rapid projection" of the four wheels, it "is sufficient to release a trigger." A tube in the fuselage contained rubber cords, the tension of which assisted in the retraction.

"We reserve placing small spring feet under the extremities of the wings and to fix at the same points, very light fish-shaped floats adapted to serve as balances for the apparatus when it rests upon the water. The inclined planes which are under the nacelle can also be housed."

The front two wheels were on swivels, but the rear wheels were fixed. Small springs kept the front wheels tracking in a forward position.

Complete, the plane would weigh 2,460 pounds, and with an engine of 20 to 30 horsepower, would attain a speed of 60 miles an hour, Penaud calculated. Octave Chanute figured that this would give a wing loading of .24 square feet to the pound, and he believed that the plane would have lacked sufficient longitudinal stability to have made a practical flight.

Chanute credits him with making a scientific balloon ascent, in which he was slightly injured; designing a plane table for plotting the course of balloons, a guide rope break, a delicate barometer, a balloon valve, a kite without a tail, a form of explosion engine, a program for experiments in air resistance, and a program for investigation of flight by means of instantaneous photography. Later, Professor Marey took up this photographic suggestion, and from his experiments came the stroboscope and, eventually, the motion picture.

What if Penaud's plane had been taken seriously? What if the development of mechanical flying apparatus had followed the direction of his sensible plans?

He would have financed and built his plane, and engineers of today agree that he would have put aeronautical research years ahead in its development.

The first powered human flight would have been in 1876 or 1878. The outlandish contraptions that occupied man's consideration between 1876 and 1900 would never have been built. Men would have abandoned the foolish plan of trying to flap huge wings with their puny arms.

Motors would have taken on a new and added importance, and it is hard to doubt that motors of sufficient power and lightness would not have been built for such a scientist as Penaud.

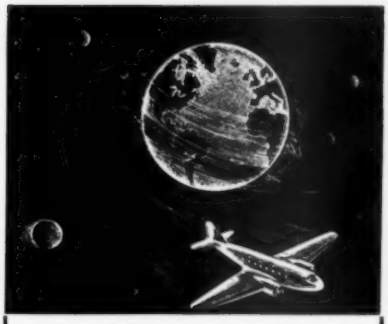
Aviation history might have jumped across the years when struts and wires and bamboos and kite structures and honeycomb structures, and all the complications conceived by the experimenters engrossed their attention.

Moreover, the face of Europe might have been changed. The history of the World War would certainly have been different, and possibly that insanity might never have happened. The airplane has a way of bringing distant people together, so long as it is not controlled by stupid men who use it as a weapon.

Penaud might have lived. Today, he would be a patriarch of 86, still confined to his wheel chair, but still shedding the benign influence of a patron saint upon the science in which he showed such promise.

As it is, however, his whole story must be written in these four saddest words—"It might have been."

END



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Santa Claus

(*Continued from page 24*)

take-off from Bar Harbor for Bangor after we were told that our scheduled refueling at the former could not be made and that Bangor had the closest available aviation gasoline.

Bill had switched over to the 20-minute emergency gas tank and started to take off from the Bar Harbor airport when suddenly the center engine quit. He stopped the heavy ship before it reached the end of the runway and taxied back. It was discovered that gas from the emergency tank, operating on gravity feed, could not reach the center engine which sits too high in the plane's nose. So Capt. Bill switched back onto the main tanks for the takeoff.

Because of Bar Harbor's being boarded up for the winter (there wasn't enough snow on the ground to make a snowball when we flew through that country) we were forced to omit eight of the northernmost "drops." Before flying approximately 75 miles inland to Bangor for gas, we had gotten as far north as Petit Manan Island in the Bay of Fundy. Even with full tanks, our gas supply would have been insufficient. We could not have flown back to the ocean so that we could finish the flight to the north and still have fuel enough to take us back to the nearest refueling point, Portland.

So "Miss La Touraine's" nose pointed south out of Bangor as we started the homeward journey down the coast. Wincapaw had purposely skipped several stations on the northward flight, some because of high tides which almost completely covered several islands and others because they were along the "inland" route we would have to fly back to Boston. These places we visited on the return flight.

Dusk was turning to darkness as "Miss La Touraine" passed over Salem and Lynn, Mass. (Here we flew at the highest altitude of the entire trip: 1,000 feet). In a few moments Boston Light flicked on as we passed to the right of it and skimmed the harbor to the floodlighted airport. An easy landing, taxi the ship into the hangar and Bill Wincapaw's 1936 Christmas flight had ended. . . .

END

Naval Aviation

(*Continued from page 16*)

This station was destined to become the center of all Navy flight training—the Naval Academy of the Air. The Annapolis camp was broken up and all personnel and equipment loaded on the U.S.S. Mississippi, which was based at Pensacola as the "aviation ship," to be used in working out joint airplane-ship operations. Comdr. Mustin became first commanding officer of the station.

Capt. Chambers was relieved of his post as head of naval aviation activities in December, 1913, by Capt. Mark L. Bristol, who today commands the Naval Air Station, San Diego.

Naval aviation went into combat for the first time in 1914, when the Atlantic fleet was ordered to Mexican waters in April in connection with the occupation of Vera Cruz. A Naval aviation section of two airplanes was attached to the U.S.S. Mississippi at Vera Cruz and a similar section to the U.S.S. Birmingham at Tampico.

The Vera Cruz planes were operated in the face of enemy fire for 43 days, scouting over the trenches around the city. Bellinger, the first American officer to fly in the presence of an enemy, returned from his first patrol with bullet holes through his wings.

In June, 1914, the Navy, looking toward trans-oceanic flying, sent Lieut. Towers to Hammondsport in connection with the construction of the twin-engined seaplane America. The World War interrupted the project. The America, forerunner of the NC boats, was sold to England and used in anti-submarine patrol service. Five years later, Towers was to command the NC boats in the trans-Atlantic venture which resulted in the first flight across by the NC-4.

When the war broke out in Europe, naval aviation suffered a serious setback, at the very time it should have been growing for the troublous days ahead. The North Carolina, now the aviation ship, was ordered to European waters with its complement of aviation officers and men aboard. It remained there until the Summer of 1915 and naval aviation virtually came to a standstill. To make matters worse, Towers was ordered to London as assistant naval attache; Herbster to Berlin and Smith to Paris.

During 1914, however, student aviators were assigned to Pensacola from time to time, in the following sequence: Ensigns C. K. Bronson and W. A. Edwards; Lieuts. Kenneth Whiting and L. H. Maxfield; Ensigns E. O. McDonnell, Wadleigh Capehart, E. W. Spencer, H. T. Bartlett and G. D. Murray.

The first Navy-designed seaplane, by Richardson, was built at the Washington Navy Yard during 1915. In this year the Navy also bought its first airship, the D-1, from the Connecticut Aircraft Co., of New Haven, accepting delivery April 20, 1915.

Lieut. Saufley established a new altitude mark of 14,500 feet in a Curtiss seaplane in 1915 and soon afterward made a new endurance record of 8 hours and 20 minutes in the same type plane. This year also saw the first catapault flight from a ship under way, made from the U.S.S. North Carolina by Capt. Mustin.

Early in 1916, the North Carolina, with five planes aboard, operated with the fleet during the Winter maneuvers at Guantanamo. On March 1, 1916, Capt. Bristol was relieved and direction of aviation activities transferred to the office of the Chief of Naval Operations, under the aide for material. Lieut. C. K. Bronson took over the aviation desk, which he held until his death in an airplane accident the following November.

He was succeeded by Towers, who held the post when the United States entered the World War on April 6, 1917, under general supervision of the aide for material, Capt. J. S. McKean. A month later Capt. Noble R. Irwin relieved Towers and carried the load of responsibility for naval aviation during the war, with Towers as his assistant. On March 7, 1918, the office of Director of Naval Aviation was created and Capt. Irwin became first director.

When the World War began the United States had only 38 naval aviators and 163 enlisted men with aviation ratings, or a total of 201 officers and men. At the Armistice there were 1,656 naval aviators; 288 student naval aviators; 891 ground officers, and 3 881 student officers under training, or a total of 6,716 officers assigned to aviation duty. There were 30,693 enlisted personnel on aviation duty, or a total of 37,409 officers and men.

The Navy sent 17,524 naval aviation

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AIRPLANE AND ENGINE MECHANICS' SCHOOL

officers and men overseas during the World War, 1,237 of the number being officers and 8,215 enlisted men with aviation ratings. Naval aviation fatalities during the war totaled 36 officers and 86 men, killed overseas, and 38 officers and 48 enlisted men killed while on duty in this country. Only one naval air station was in existence on April 6, 1917. At the Armistice there were 24 stations and schools operated by the Navy, one of them in Canada.

The naval appropriation act of August, 1916, made provision for a Naval Reserve Flying Corps and as soon as it became apparent this country would enter the war, groups of college men got together and applied for enrollment. The first group, under leadership of F. Trubee Davison, later Assistant Secretary of War for Aviation, consisting of 29 men, was enrolled in January, 1917, and immediately began training at Palm Beach, Fla., in their own seaplanes and at their own expense.

A second group trained at Newport News and a third at Buffalo. In each case a naval aviator was in general charge. This gave naval aviation a nucleus of capable young officers and proved of inestimable value in building up to war strength.

Twenty-five years! The puny, wobbly fledgling has developed into an eagle so powerful and so fierce that there is arising in the minds of men serious doubt whether civilization itself can survive a full unleashing of its power. There are those who question whether in another 25 years there will be any military aviation or any armies or navies, except for police purposes.

They visualize either a civilization beaten to earth by self-made destructive forces too powerful for it to endure, or a universal peace enforced by the realization that there are but two alternatives—universal peace or the utter destruction of governments and civilization as it is now known.

END

Pro—

(*Continued from page* 40)

It was my intention to end this libelous treatise at this point, but upon checking back I find that some things have been said that might be regarded as being personally directed at certain people.

My opinions, as stated here, refer to two groups and not to any individual. They are my opinions acquired from five years of flying, and contact with flyers.

In the years that have passed since the California Aerial Transport School bowed me out the door with a hard-earned license in my pocket, it has been my good fortune to work with some of the top-notchers of the flying game: Frank Clark, "Baldy" Wilson, Al Wilson, Leo Nomis, Dale Straw and J. B. Alexander. Four of these are dead, dead because they gambled their lives against dollars that the lens of an Akeley Camera might catch a scene to thrill a satiated theatergoing public.

Those that are, and those that were,—all fine fellows and fine flyers. I am proud to have served my apprenticeship under them.

END

—Con

(*Continued from page* 41)

eights. He's going to have to develop a clean cut, accurate system for landing, making the same pattern with respect to the tee each time he comes in for a landing, approaching at the same altitude, and shooting for a spot on each and every landing.

If he'll do these things, will work at them until he is master of each one, the fact that he is a pilot, which is something more than a ticket-holder, will assert itself over and above ninety-horsepower and a 70 mile top speed.

END

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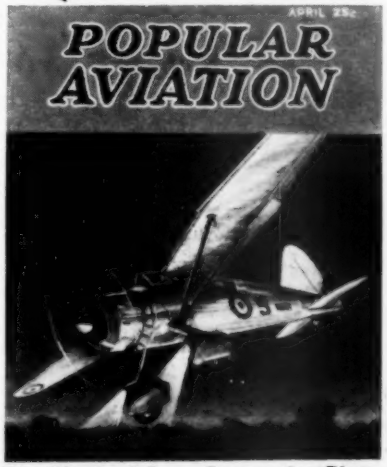


The Westland Army Cooperation Plane

Rockets

(*Continued from page 32*)

whether living creatures are able to exist there.

"After the rockets are spent, the machines will float back to earth again, suspended from parachutes which open automatically the moment upward movement ceases. Later, rockets will be sent up with crews in airtight compartments, equipped with oxygen and inhalation apparatus.

"We are convinced in rarefied air, where no streams or even winds exist, it will be possible for airplanes to develop a speed of 1,000 kilometers an hour and to sail along enormous distances with very little use of fuel. In the end we may try to penetrate space, but it is still a dream.

"We know our experiments will concentrate the interest of the entire scientific and technical world on the construction of rockets, and all nations will shortly compete in the solution of this problem. What we are showing now is but the beginning of the turning point in aerial navigation."

He ceased speaking. The hum of many voices rose from the crowd. He walked to the little car and got in. The crowd was quiet now—watching, waiting.

There was a sudden explosion. A long jet of smoke and flame shot from the rear of the car. The machine hurtled forward at tremendous speed. Other explosions followed, and the speeding car could not be seen for its clouds of smoke.

Within two seconds its speed was 100 kilometers (about 62 miles) an hour; and as the rockets contined to explode the speed continued to rise suddenly, until von Opel was traveling at 250 kilometers or about 155 miles an hour.

Now his rockets were spent. The towing truck came and towed the little car back.

A pandemonium of applause greeted him. For fully an hour the people cheered this pioneer in a new art of mankind.

Fritz von Opel had ridden this wild, exploding, racing gun of a car, and escaped with his life. He had been lucky . . .

In the next two tests of rocket cars, without pilots in them, each machine was exploded and destroyed.

Max Valier, the first and most scientific of the three experimenters, now began making experiments with the intention of building a rocket-driven airplane to attempt a transatlantic flight. During the experiments, however, differences rose between von Opel and Valier, and their partnership was broken.

Von Opel and Sander now began planning an airplane to be driven by powder rockets while Valier, seeing that the cost of explosive powder would prohibit its extensive use in aircraft, began to consider the use of liquid fuel in rockets.

But before abandoning the powder rocket he decided to try it a few more times. In a racing car he made up to 112 miles on two tests. In the third test the car made 131 miles an hour, overturned and was wrecked. He now turned to ice sleds. On frozen Lake Starmberg he drove a rocket sled at 235 miles an hour.

But he still wasn't satisfied with explosive powder as fuel and so he turned to the liquid fuel rocket motor.

Over in America, Robert Goddard was still experimenting with liquid fuel rockets. He had been thinking for a long time that powder rockets were too uncertain, inefficient, dangerous and costly to be used in human propulsion.

Nevertheless, Fritz von Opel and Friedrich Sander began designing a bobtailed airplane to be driven by explosive powder. Fritz von Opel was eager to risk his life in testing out such a craft.

On September 30, 1929, while Max Valier was still working in secret on his liquid-fuel rocket car, some two months after Goddard's first liquid-burning instrument-carrying rocket had successfully been shot into the air—the "Opel-Sander Rak 1," the first rocket-driven airplane to be tested with a pilot aboard, was waiting on its rocket-actuated catapult, ready to be shot into the air.

The short little craft had no landing-gear. Above its short fuselage stretched a monoplane wing. Its tail had the appearance of being cut sharply off; there in the rear was the magazine for the rockets—sixteen of them, eighteen inches long, three inches in diameter. They were to be fired by electric wires.

Von Opel finished inspecting the rocket ignition wires. He knew that if something should make several of those wires contact at the same time his life would go up in a blast of flame and smoke. Satisfied somewhat, he climbed into the cockpit.

The mists lay low over the valley. He would have to fly into those clouds. He felt uneasy.

He always felt uneasy when he started to drive a strange car or speedboat. But as the craft started, confidence always came to him. Sander walked up and shook hands with him again. Von Opel saw that Sander was worried about him, and was touched.

"All will be all right," von Opel said. "This is the great moment we have worked for."

Sander moved to a safe distance. Women and children hurried from the vicinity.

Von Opel waved to the waiting electrician to set off the three launching rockets. The man pressed a switch.

The spectators held their breath. Flame and smoke shot from the rear of the plane, with a powerful, swishing sound.

In a cloud of smoke the strange craft leaped upward.

In the cockpit young von Opel's heart was hammering his chest. "My heart is still beating—I'm still alive," he thought.

He must start firing the rockets. Drawing a deep breath he moved the switch. The plane hurtled forward. Its sudden increased speed almost suffocated him. He wondered if the wings would break.

The next moment he realized he was still safe. He made contact and exploded another rocket, and pulled the plane sharply up into the air. At the tremendous speed he could hear only an even roar.

He felt confident now—master of this new craft of the winds, this craft that should circle the world in five hours. His old dream of the world traffic of the future and the world race of man that would move in it made him feel the great importance of this, man's first rocket flight.

Suddenly, the rockets ceased firing. He must land.

He glided down steeply in the mists, looking desperately for a landing place. Then he saw a row of trees ahead. He was headed straight for them.

In fear for his life he quickly fired a reserve rocket. The plane zoomed. He cleared the trees.

Now he side-slipped to a hundred and fifty feet above the ground; and the next minute he brought the wheelless craft to the earth.

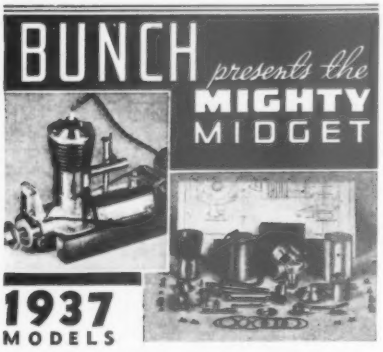
There was a crash, and a bumping slide.

For a moment he sat still, numb, vaguely, instinctively glad that he was alive.

The spectators were coming in a hurry . . . They saw the young pilot hop agilely out of the cockpit. He pushed back his tousled hair, and seemingly calm, even nonchalant, with a smile on his handsome face, stood looking at the wreck. . . .

Thus, did man fly in the first rocket ship made on the earth.

END



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Signals

(*Continued from page* 35)

flying system. Also, it has developed an instrument landing technique on the radio compass.

But in training, the desirability of a variety of problems not available with "honest" instrument flying toward genuine radio stations suggested the new training control system.

Capt. Crane started the project when assigned to Randolph Field, student training center, in 1932. He was transferred to Wright Field a year and a half ago and brought the project with him, but it was inactive until recently.

The system makes it possible to simulate not only radio destinations, and therefore navigation and control problems, but to indicate arrival at those destinations by a marker beacon signal also at the instructor's volition.

In other respects, too, the student is at the complete mercy of the instructor. The man under the hood can be made to think he has traversed perhaps twice the distance actually covered; in other words, as far as he is concerned, he might be flying a fast pursuit or bombing plane instead of the relatively slow trainer or observation ship.

The ground training system offers complete safety and its exponents say that a student can learn flying under the hood without even leaving the ground. It's great stuff for anyone who wants to eat his cake and have it, too, but the matter is taken so seriously by the army that as a result of the board's appraisal the contrivance may become standard equipment at Randolph Field.

The ground trainer is an expensive unit, not in any sense a toy, although the student sits in a trunk-like compartment fitted with vestigial wings and tail that make it look like the midget airplanes you see in an amusement park. Fact is, a good promoter probably would snap at the chance to get one of the trainers for an attraction.

It is like this: the student climbs into the single seat, closes the door and pulls down the hood. Thus hermetically sealed, and saved from suffocation only by a fan (no place for a claustrophobia) he turns on the ignition and an electric motor hums. With his eyes on the instrument panel, he handles the controls just as he would for a regular take-off. The standard instrument panel has radio dials.

The flyer's earphones give him signals that let him know the direction of the radio beam, and once on the beam he follows the aural signals to stay on it. Another signal tells him when he has arrived. Instructor and student may converse.

On a nearby table, meanwhile, at which the instructor sits, a gadget on three wheels, called a "crab," because of the way it crawls, follows in scale the flight path, across the face of a chart. The crab, connected with the "plane" by wires, leaves a penciled mark as it moves.

When you stop the motor and climb out you may see exactly where you have been. The student has climbed and glided at various points just as in regular flight. If he climbs too abruptly, losing speed, the plane goes into a spin—and does actually spin. Also, it points up in climbing and down in gliding.

Plane

(*Continued from page* 16)

flaps but the plane has a low landing speed. The specifications and performance figures follow:

SPECIFICATIONS

Wing span	31 ft.
Overall length	24 ft. 2 in.
Overall height	7 ft. 3 in.
Wing area	140.5 sq. ft.
Empty weight	1125 lbs.
Useful load	875 lbs.
Gross weight	2000 lbs.
Horsepower	125
Take off run	390 ft.
Rate of climb	1020 ft.
Cruising range	730 mi.

END

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1 oz. 5c
1/2 pt. 30c
Clear Cement
1 oz. 5c
1/2 pt. 25c
1 pt. 45c
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20x30", 1 for 9c
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Reed
1/32, 1/16"
..... 3 ft. 1c
1/8" .... 3 for 2c
Wooden Wheels
1/2", 2 pair .. 3c
3/4", pair .. 2c
1", pair .. 4c
1 1/8", pair .. 4c
1 1/4", pair .. 7c
Celluloid Wheels
3/4", pair .. 5c
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doz 1c
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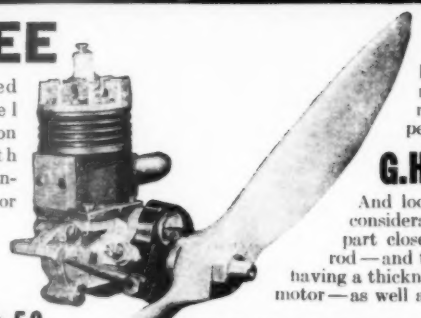

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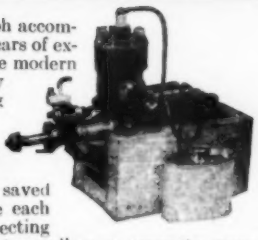

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6. Cylinder and piston lapped.
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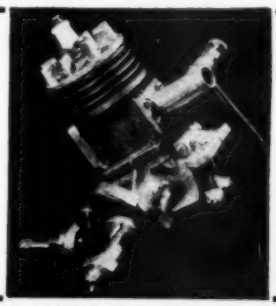
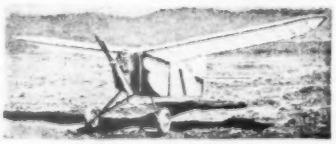
11. Main bearing is high-speed bronze, ground and lapped to size.
12. Condenser is gas, oil and water proof.



G.H.Q. Outstanding Performance

13. Cylinder and piston inspected cast iron to insure long life.
14. Chrome nickel steel shaft with 1¼" bearing surface.
15. Connecting rod of high speed bronze.
16. Carburetor assembly accurately designed and made.
17. Needle valve and valve body machined together.
18. Breaker assembly compact, fool-proof, long wearing, replaceable and adjustable.
19. Easily inverted and runs in either direction.
20. Motor starts and runs on 2-ounce battery.
21. Speed range 500 to 10,000 R.P.M.
22. Low gas consumption—runs 27 minutes on one ounce of gas.
23. Strongest miniature motor.
24. LOWEST PRICE EVER SET.

G.H.Q. Sportster Kit



The G.H.Q. Sportster kit especially designed for G.H.Q. Gasoline Motor but may be used for any other motor of like weight and power. Built according to scientific aero-dynamic principles —Has made hundreds of successful flights without crackup—Marvelous glider . . . And what a climber! A complete kit of all parts including plan, all wood, wire, wheels, metal and all other parts. Postpaid for only..... **$5.00**

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Here is your opportunity to obtain a kit of this famous motor. Assemble it easily yourself and save money.

Everything is in the kit including plug, coil, condenser, tank, ignition wire, cylinder, piston, connecting rod, timer, crankshaft, all screws, nuts, bolts, etc. No oil, gas, batteries, or propeller included.

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"We warrant each new G.H.Q. gasoline engine manufactured by us, to be free from defects in material and workmanship under normal use and service, our obligation under this warranty being limited to making good at our factory, any part or parts thereof, which shall, within ten (10) days after delivery of such motor to the original purchaser, be returned to us with transportation charges prepaid, and which our examination shall disclose to our satisfaction, to have been thus defective; this warranty being expressly in lieu of all other warranties expressed or implied and of all other obligations or liabilities on our part, and we neither assume nor authorize any other person to assume for us any other liability in connection with the sale of our G.H.Q. gasoline engine."

"6 Months—Holding up Strong"

Richmond Hill, L. I.
December 26, 1936

G.H.Q. Model Airplane Co.,
854 East 149th St., New York, N. Y.

Dear Sirs:
About six months ago, I bought one of your motors and it has given me great perform ance.
I just want to say that after 6 months it is still holding up strong.

Respectfully,
PETER DRAVIER

G. H. Q. MODEL AIRPLANE CO.

854-P East 149th Street NEW YORK, N. Y.

Swanee Taylor

(*Continued from page 29*)

Young Randall, whose pop, Wayne Randall, is director of publicity for NBC, was encountered stomping around Radio City clad in natty blues which raised havoc with sopranos and crooners alike. Pausing, in between appointments with Jessica Dragonette and the Lullaby Lady, Cadet Randall displayed all the staggering aplomb of a 50-hour bird. Yes, life at the Pensacola Air Station is everything to be desired; the Florida State College for Women is over at Tallahassee, only three or four hours away. No, the discipline isn't harsh; they are awfully serious, though, about that commodity called alcohol. Boozers or rum-dums aren't wanted. About the future; well, fifty percent of the class aim for trans-ocean jobs when they leave the Fleet three years hence. By then experienced over-water pilots will be in great demand. Getting a good shake from the Navy; a great shake indeed. Everybody is most appreciative and consistent in treating the young fledglings as freeborn men. Service life attractive; golly yes. So much so that about a dozen of Randall's class, he among them, are taking examinations for permanent commissions in the Marine Corps.

When at last the snappy young fellow loped off to quaff a saucer of tea with the Lullaby Lady, and explain to her the Sweet Mystery of Flight, I somehow got a feeling that he'd click; in the Marine Corps.

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All col., doz. 10c
Silver ....ea. 5c
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WHEELS per pr.
Brch Balsa Celu
1/2 .01 .03
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1 .03 .05 .07
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2 .15 .20
PINE WHLS., pr.
Both sides alike
3/4" 4c; 1" 6c
1 3/4" 8c; 1 7/8" 12c

NOSE BLOCKS
1x2x1 ..... 1c
2x2x1 ..... 2c
2x2 1/2x1 ..... 3c
3x3x1 ..... 5c
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24 and stripes 5c

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1 doz. 1/8 or 1/4 1c

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Small ...doz. 10c
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3/4x1 1/4x12 2c ea.
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.0005x3 1/2....ft. 1c
.005 in. 6x6 5c
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5c per oz.; 1/2 pt. 30c; 1 pt. 45c

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Same as clear dope

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5c per oz.; 1/2 pt. 35c; pt. 60c

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5c per oz.; 1/2 pt. 35c; 1 pt. 55c

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5" 4c; 6" 5c
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BAMBOO
1/16 sq.x12, 36, 5c
1/16x1 1/4x15, dz. 10c

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1/16x6 ...doz. 5c
1/8x18 ....2 for 3c
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WIRE
6-8-10-12-14
.....2 ft. 1c

WOOD VENEER PAPER
20x20....1 for 10c

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2 for 15c

CELLULOID
6 x 8..... 5c
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12" 10c; 15" 15c; 24" 20c.

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Small 3c; Lg. 5c
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1 1/2" d. 18c; 2" d. 20c; 3" d. 25c.

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1 1/2" dia.....18c
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CELLULOID PANTS, per pair
1/2" to 1" 18c
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METAL PROPELLERS
2 bl. 3 bl.
1 1/2"...5c....08
2 1/2"...10c....10
3 1/2"...15c....20
4 1/2"...20c....25

ALUM. TUBING
1/16,3/32, 1/8 ft. 7c
3/16 or 1/4, ft. 10c

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1 1/2" 15c 2" 18c
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Specify whether anti-drag or closed.

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3/4"..4c 1 1/4"..7c
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1 1/4" 10c 1 3/4" 15c

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3/4", 1 1/4, or 1 3/4", each 5c

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1/16....4 for 1c

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1/2" or 1" pkg. 5c

SANDPAPER
Doz. sheets....5c

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doz. 8c

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Small 15c
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Sparrow Hawk, Boeing Trans. 247, Spad Chass., Vought Corsair, Curtiss Swift L. W., Waco Cabin Biplane, Douglas Dolphin, Boeing P12F, Fokker D-VII, S.E.5, Goshawk, Gee Bee, Boeing P26A, Monocoupe, Northrop Gamma, Fairchild 24 Cabin, Corben Super-Ace.

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Scud . . .

A movement is afoot to revive the National Air Pilots Assn., with the view of furnishing mutual insurance protection to pilots everywhere. All old NAPA Beneficiary Dept. members please write me how you feel about this. It'll be the same nonprofit plan run so splendidly by our dead friend Carl Egge. . . . Aviation (Col. Gorrell) will do well to thank the thousands of CCC boys who went out in horrible weather to search for those lost ships. Don't forget to say thank you, pals. . . . Recommended reading: "Your Wings" by Assen (Jerry) Jordanoff, whose earlier "Flying and How to Do It" helped many a baffled student over the rough spots. "Your Wings," much bigger and better, should be read by every man, woman and child who ever hopes to get 'em. (See the Air Associates Inc. ad about getting one painlessly and promptly). . . . Also, "Wings Over Texas," by T. S. Terrill, makes for excellent, authentic reading. It is the story of Flying Cadet training in the Army, done in diary form. A delightful dish for every true air fan. . . . A sample of Mutual Broadcasting System good taste: Announcer (speaking lugubriously of the Western Air crack-up), "And now ladies and gentlemen, while we wait for our short wave broadcast from the scene of the crash we will listen to the music of (brightly) DUKE ELLINGTON!!!!". . . . *HOT COPY:* Rumor persists that the Insurance Underwriters will soon crack down on those careless air line pilots. They've been gathering evidence for a year and the union won't help the offenders a bit.

Airy Chat

(*Continued from page 12*)

John Huntington, Columbus, O...2:37 "
Verne Andrews, Athens, Ohio....2:55 "
C. T. Fitzer, Athens, Ohio.....4:00 "
Cletus McPherson, Albany, Ohio..2:45 "
Howard Wingo, Albany, Ohio....3:25 "
Roger Jones, Athens, Ohio.....2:42 "
Don Burdette, Athens, Ohio.....3:47 "
Parker Walker, Athens, Ohio....3:10 "
Paul Jones, Athens, Ohio.....2:15 "
D. E. Robinson, Athens, Ohio....3:45 "
John Cline, Athens, Ohio.....3:22 "
Dow Grones, Athens, Ohio.....2:15 "
J. O. Pilcher, McArthur, Ohio....2:45 "

Mr. Knoeff states that his partner, Bob Swift, has conducted about 1,500 hours of flying with approximately 100 students without any sort of accident. Thanks a lot.

* * *

PENAUD, one of the earliest of aeronautical experimenters and inventors, has heretofore received but little attention by the aviation press; therefore our readers will be highly interested in a detailed biography of this most ingenious and versatile French scientist. Likewise, our young model builders will, probably for the first time, learn of the man who first devised the "flying-stick" type of model that is the basis of all model flying.

His genius covered the entire heavier-than-air division of aeronautics, for he built models of ornithopters, helicopters and true airplane types early in the century and drew up constructional specifications that were amazingly modern. But, like many another inventor, he was too far ahead of his time.

* * *

PENAUD did not belong to the present type of airplane inventor who gains great acclaim for changing the shape of a wing or for inventing a new ruder hinge. His inventions were basic, covering the fundamental elements of three types of aircraft which were ultimately to prove the inspiration of the Wright Brothers.

* * *

ANOTHER feature of great interest in this issue is the concluding article on tailless planes by Lewis Owen who was assisted in this work by Raoul Hoffman, designing engineer of the Arup. As will be seen from the article, there have been many developments in the flying-wing type of plane by many inventors, but so far as their practicality is concerned, they have—so far—proved of little merit.

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NEW CURTISS F11C4 NAVY PURSUIT

28" Span. Length 20½". Weight 4 oz. 1" Scale

THE MOST EXCLUSIVE AND FINEST EQUIPPED MODEL IN THE WORLD
A special De Luxe model, one of the most beautiful and finely detailed ever made, with its special exact scale 3⅜" celluloid, 1000 H.P. type, Wright Cyclone motor, having aluminum push rods, cylinder fins, etc., like real motor. Also in set are 4" aluminum cowl ring, 9" carved spruce semi-scale flying propeller, colored star and rudder insignia, 2" celluloid balloon wheels, silver dope, paint, black, red striping, Navy lettering, wire parts formed, axles, rubber motor, windshield, instrument board, flying wires, 4 aluminum step plates, aluminum wing walks, ready cut wheel pants, etc. All other parts printed on balsa. Detail scale drawing. **$4.50**
Construction Set complete, postpaid

41" LOCKHEED ARMY SPEED VEGA

41" Span. Length 28". Weight 8 oz. 1" Scale

This new model, built very strong yet light in weight, is practically crashproof and will out-perform any large scale model built. Rises from ground in 10 feet and flies over 650 feet. Set contains all parts printed on balsa, ready cut pant cores, 4¼" turned motor front, 11" steel type carved paulownia wood propeller, 2½" balsa wheels, tail wheel, formed wire parts, 26" rubber, 3 oz. yellow dope, 2 oz. blue, ⅛ oz. black, 2 oz. glue, cement covering, full size scale drawing, and all parts. **$4.95**
Construction Set complete, postpaid

NEW BOEING P26A ARMY FIGHTER

22" Span. Length 17½". Weight 2½ oz. ¾" Scale

Above photo shows finest equipped model of this plane on the market. Having ready made motor, cowl, prop, etc., it is very easy to build and is a beauty. Const. set contains 3" celluloid motor, 3¼" spun tapered aluminum cowl ring, 8" steel type paulownia wood prop. 1⅜" celluloid wheels, tail wheel, insignia, windshield, instrument board, 1 oz. yellow dope, 1 oz. blue, cement, glue, all parts printed on balsa, and drawing. **$2.75**
Construction Set in labeled box, postpaid

NEW LOCKHEED P24B ARMY FIGHTER

32" Span. Length 20½". Weight 3½ oz. ¾" Scale

New scale special detailed model, equipped with 2" pneumatic rubber tired M. & M. air wheels. Set also includes ready made and painted pilot's bust shown, 2 aluminum step plates, 9" carved steel type prop shown, all parts printed on balsa, turned balsa motor front, 3 oz. colored dopes, paper cement, 2 oz. glue, covering, colored insignia, formed wire parts, nose plug with brass bearing, rubber, 9 metal motor exhaust pipes shown on cowl, full size scale drawing, and all parts to build. **$3.75**
Construction Set complete, postpaid

1937 CATALOG Send 3c stamp for 8"x10" beautifully illustrated Catalog containing large photos of the world's finest scale models.

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NOTE THE VALUE. Our models are only ones on market equipped with steel type carved propellers, celluloid or aluminum wheels, celluloid motors, aluminum cowls, etc. No other models equal them for flight or appearance. Build one and be convinced!

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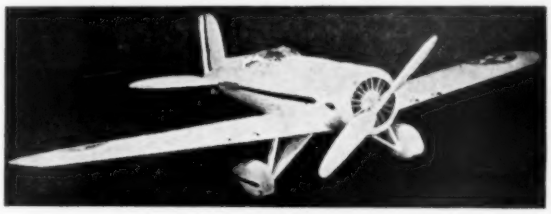
NEW LOCKHEED P23A NAVY FIGHTER



COMBINATION LAND AND SEA PLANE SET
32" Span. Length 20½". Weight 3½ oz. ¾" Scale

New 4-gun Navy fighter. Model will rise from land or water in few feet. Construction set contains fuselage and pontoon formers, wing ribs, tips, etc., printed on balsa, a 3⅜" turned cowl front, 2 instrument boards, colored insignia, lettering, windshields, 9" carved scale flying prop shown, 3 oz. silver paint, 1 oz. cement, ¼ oz. black, 2 oz. glue, ready cut wheel pants, strong 2" aluminum wheels, 12 feet of rubber, and large 33"x44" drawing of land and sea plane. This is a sensational model and only one of its type in the world. **$2.95**
Construction Set in labeled gift box, postpaid

NEW BOEING F4B4 NAVY FIGHTER

New Improved Detailed Model

22½" Span. Length 14½". Weight 2½ oz. Color, Grey, etc.

This is the finest equipped Boeing F4B4 model in the world. New improved model exclusively equipped with new 3¼" special aluminum streamline tapered cowl ring, 9 cylinder celluloid motor with aluminum ventilator front, 8" carved varnished steel type propeller, printed out balsa wood parts, 2 oz. grey dope, ⅛ oz. yellow, ⅛ oz. red, paper cement, glue, formed wire parts, celluloid wheels, tail wheel, U. S. Navy lettering, colored insignia, and ¾" scale drawing. **Construction Set complete, postpaid** **$2.95**

NEW NORTHROP FT1 NAVY FIGHTER

22" Span. Length 15". Weight 2½ oz. ¾" Scale

A beautiful flying model of the latest Northrop 280 m.p.h. fighter. Set contains 3" turned motor front, 8" carved propeller, insignia, silver, black and clear dope, glue, all parts printed on balsa, full scale drawing, and all parts to build as shown. **$2.00**
Construction Set complete, postpaid

LOCKHEED R20-1 NAVY ATTACK

27½" Span. Weight 3½ oz. Color, Silver, etc. ½" Scale

Model is fully detailed with authentic wing rib and body stringer spacing. Every air-minded boy will want this powerful-looking model. Motor power is run through the fuselage and is concealed—a special exclusive feature.

Set contains 2 standard steel type carved wood propellers, 16" rubber, star and rudder insignia, all parts printed on balsa, 2 turned balsa motor fronts, balsa air wheels, silver dope, black, glue, full size scale drawing, and all parts to build. **Construction Set complete, postpaid** **$2.95**

Note: Orders sent West of Miss. or Foreign, add 20c postage

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MINIATURE AIRCRAFT CORP., 83 Low Terrace, New Brighton, New York

Here and There

(Continued from page 20)

According to Col. Edgar S. Gorrell, president of the Air Transport association, the airlines will offer for approval by the Air Commerce bureau pilots' recommendations for the types and locations of the new equipment designed chiefly for replacement and modernization of obsolete radio range broadcasting stations.

Complete rehabilitation is scheduled for radio facilities at Chicago, Washington, Los Angeles, Atlanta, Miami, Indianapolis, Louisville, St. Louis, Detroit, Pittsburgh, Camden, Newark, Spokane and Columbus.

* * *

The business of eating in the air opens a new field and major airlines are realizing the importance of this service with the announcement by United Air Lines of the appointment of Donald F. Magarrell as maitre d'airline, the first flying executive in charge of cuisine in the world.

More than 375,000 meals will be served annually in the air by United under the direction of Maitre Magarrell, in addition to thousands of meals served at airports.

During the past ten years, dining in the air has advanced from the sandwich and apple stage to a matter of serving well-balanced full course meals three times a day.

* * *

C. R. Smith, president of American Airlines, reviewing the twelve months period just ending, declared that the company carried more than a quarter million passengers and 800 tons of air express over its nation-wide system creating the greatest year the company has experienced.

American Airlines has also placed orders for ten additional Flagships to be delivered by the Douglas Company in early spring, bringing America's fleet of planes to 44 Douglases and 15 Stinsons.

* * *

Eastern Airlines has replaced the pretty little hostesses with male flight stewards.

According to EA the move is for the purpose of uniform service with connecting Pan American and will also provide a good training for the young men who may later desire to enter other branches of air line service. . . . There's a good opportunity for you young fellows who are anxious for a career with the airlines other than piloting.

* * *

Milton Van Slyck has been named assistant to President Jack Frye of Transcontinental and Western Air and will assume his new office in Washington immediately.

For the past ten months Van Slyck has been public relations manager of the TWA central region located in Chicago. Bill Bishop, formerly of the State street council, is slated for his job. . . . E. A. Hecker is now express manager of General Air Express.

* * *

Dan Cupid is still the boy with the right kind of wings for the airline hostesses and according to Miss Rosalie Gimple, chief stewardess of United Airlines, twenty-eight of the lines 150 girls have resigned to marry.

* * *

Applicants for the vacancies must promise not to get married, at least not right away. . . . Miss Jeanne Baird, chief stewardess of food service for American Airlines, has married Tom Ferris, Toledo newspaperman.

* * *

Curtiss-Reynolds airport, Glenview, Ill., has been designated as the new naval reserve air base and removal of equipment from Great Lakes will begin in the near future.

Engineers are preparing plans for permanent quarters for a staff of twenty-two training officers and space for sixteen airplanes.

Over at Palwaukee field where Bill Turgeon does the instructing, Dr. Eugene Cary, of the Drake hotel and senior obstetrician at St. Luke's hospital, may be seen flying his own plane on emergency calls to distant points where his services are needed.

The noted doctor has been flying since the spring of 1918.

* * *

Hirohisa Nishi, Japanese scientist, claims to have invented a device which will enable airplanes to ascend vertically and to increase horizontal cruising speed at least 25 per cent.

END

If you plan to learn flying, if you hope that some day you'll know the thrill of piloting a plane, this big new book "YOUR WINGS" is the book for you.

With the aid of hundreds of scientifically exact drawings the author carries you step by step through a course in flying instruction from the first flight to blind flying and advanced aerobatics. This tabloid method of teaching allows a quick grasp of the subject; the functions of instruments, engines, radio compasses, automatic pilots, all become obvious at a glance.

"YOUR WINGS" incorporates everything about flying that can conceivably be taught by word and picture; nothing like it has ever been available before. Everyone will want a copy of this remarkable new book that tells the complete story of flying. Send for your copy to-day.

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MASSACHUSETTS INSTITUTE OF TECHNOLOGY LIBRARY

No Progress

(*Continued from page 30*)

where the philosophy of life is, "My honourable ancestors carried freight on their backs. What was good enough for them is good enough for me."

The flimsy contraption in which the Wrights flew was composed mainly of a pair of wings, an engine of some sort, and two big propellers. Therefore the manufacturer says, "The Wright brothers used wings to lift them off the ground, so wings are a necessity to airplanes. They can't fly without them."

Many persons are of the opinion that because birds have flown with wings for thousands of years, an airplane should follow after them. Science has developed lifting surfaces which excel those of a bird's wing. The only difficulty encountered is the fact these surfaces in no way resemble a wing. Therefore before even considering their worth, people condemn them. That attitude doesn't make for progress. It retards any steps ahead.

Some years ago the Flettner rotor principle was incorporated in a plane. (The rotor is a cylinder which rotates at high speeds, forming a vacuum on top and pressure on bottom for lift.) This principle proved sound. The rotors surpassed standard wings in lift by a ratio of ten to one. This craft was ridiculed because of its odd design, although it was a great step in aviation history. Little has been done in this field since then, development on this particular craft being discontinued due to lack of funds.

The government has hindered progress considerably due to its restrictions and strenuous campaign against privately built aircraft.

Before a new design can even leave the ground a small fortune must be spent on engineering data. Many revolutionary advances in aeronautical progress are shelved because the designer hasn't the financial ability to wade through red tape. It is the practice of the Department of Air Commerce to frown on any craft which strays from the standard form of construction and design.

The claims of efficiency in modern aircraft are largely myths. The general idea is, for more speed, to install more powerful engines, not improve on the design. It is roughly estimated that a plane capable of doing 120 miles per hour with a 200 horsepower engine, would require about 800 horsepower to double that speed. Where is the efficiency?

The idea airplanes are impractical unless they develop tremendous speeds is foolish. What method of ground transportation can travel at a steady pace of 120 miles per hour, across the continent, with safety?

Coupled with the wasteful practice of cramming more and more power into an antiquated design is the decrease in engine efficiency during the last few years.

I have before me the specifications of a new high speed, eight place, transport plane. The top speed is 210 miles per hour. It cruises at 190 miles per hour and lands at 63. The total power developed by its twin engines is 740 horsepower. The fuel consumption is 49.5 gallons per hour, or 24.75 gallons per hour per engine of 370 horsepower.

The old Liberty engine produced during the war, and one of the most famous of engines, developed 418 horsepower with a fuel consumption of 18 gallons per hour. Thus, twenty years after this engine was built, with all the ballyhoo as to progress, the modern engine uses half again as much fuel per horsepower. Some progress.

Some time ago, a west coast man designed a super-efficient aircraft engine. It weighed about one-half as much as the ordinary airplane engine and used half the fuel. This man spent quite a few years in the development of this engine before exhibiting it. He then took it to the chief engineer of a large aeronautical manufacturing company.

The engineer, after testing it thoroughly, proclaimed it the greatest advance in gasoline engine design since its beginning. However, when submitted to the president of the firm, the answer was, "We build pretty good engines as it is. We haven't had any complaints. Excess gas consumption? Oh, well, gas is cheap. Excess weight? Well, that only amounts to a slightly less carrying capacity."

All things considered, the manufacturer can't be blamed. The real blame falls on John Q. Public for his lack of interest. For instance, John Q. notices in the rotogravure section of his newspaper a picture of a new transport, together with a story as to its tremendous speed, etc. John Q. looks at the picture and sighs, "Gosh, I wish I could afford to make those business trips by air." He has compared prices and found travel by bus or train cost about one-fourth that of air travel.

John Q. criticized the railroads when they fought a one cent per mile reduction in fares, but he doesn't murmur a word about the high cost of air travel due to inefficiency. Perhaps he doesn't realize that he pays for air travel in the form of subsidies which, of course, come from his pocketbook. Perhaps he doesn't realize that subsidies are necessary because of inefficiency. Perhaps—Oh, what's the use!

END

Diesel Engines

(*Continued from page 38*)

pump to inject the fuel. They call this system "solid injection." There are many types of pumps designed for solid injection. They force the oil into the cylinder at the tremendous pressures of from 3,000 to 20,000 pounds per square inch—at a mile under the seat, if you could stand it, you'd find a pressure of 3,000 pounds, but you'd have to dip a little further to the outlying suburbs of the sea, down to nine miles for the stupendous pressure of 20,000 pounds.

The unit injection type, found in most Diesel engines, reduces the pressure to as low as 1,800 lbs. per square inch, which permits much less weight per horsepower and was the key accomplishment in making possible Diesel engine mass production.

In any solid injection system it is first necessary to have a pump to accurately meter the fuel charge, and to inject it into the cylinder against the compression pressure of 500 or 600 pounds per square inch. In the unit injection system (which seems to be the most practical) each cylinder has its own fuel pump to supply the spray nozzle which breaks the oil into a mist-like spray as it is injected into the cylinder. Each of these unit injectors is built to such exact limits that each cylinder will receive the same amount of fuel, and so develop the same amount of power.

This, I may say, is the heart of a Diesel's success—and this is where precision in manufacture is translated into superiority of engine performance.

But even the engineers cannot tell about the Diesel system of power in hours of steady talking, so how can I hope to? It is my simpler job to talk about that power in the making and in action, with a moral as to what it all may mean to industry and, what is more to the science of aeronautics and to airline operators.

END

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Air Board

(*Continued from page 28*)

generally results in a crash, and radio being what it is, we know that it does go out too frequently.

"One of the causes for failure of radio is static, due to rain, sleet and snow conditions. In short, under conditions where the radio is needed the most, there is the greatest danger of its failure, and any experienced pilot knows that if a pilot is flying by instruments under conditions of no visibility, he is almost entirely dependent upon his radio for safe arrival at his destination.

"A safe landing anywhere at all under these conditions, without radio, is purely a matter of luck, and we can not base a passenger operation upon luck.

"It seems to me that there are three kinds of competition involved in such operation:

"1. Competition between the separate air lines themselves.

"2. Competition between the air lines in general and other means of transportation.

"3. Competition between the individual pilots of any given air line.

"Reasonable competition is healthy, but when it is carried too far, becomes dangerous. Theoretically, a pilot does not have to go through if he considers the weather too bad, but if he misses too many trips, he will be out of a job.

"After a hundred years of steamships, even the greatest vessels today do not continue ahead at full cruising speed in dense fog, nor do they attempt to get up into the docks of New York at any speed at all if the fog is dense, but are forced to anchor and wait for better weather.

"In short, too many times we read headlines about a dozen people being killed in an air line crash, and in the next column statistics put out to show the growth of air travel, and not the percentage of trips completed, etc. Dead customers are not very good advertisement for any transportation system. It is time that air line operators and the Bureau of Air Commerce gave serious thought to this, and realize that they are crowding their luck too far.

"I realize that this is a dangerous subject, but at the same time, I think that any one sincerely interested in the growth of aviation will agree that the prime requisite is safety. A fine safety record with considerable speed and percentage of trips completed is a lot better than a higher speed record with inadequate safety.

"Regarding the Braniff crash, apparently, from the newspaper accounts, it must have been caused by engine failure very shortly after take-off. There is food for thought in this, because presumably it was a two-engined airplane. Secondly, why should five people be taken up on a test flight after an overhaul?

"An occasional serious crash is bad enough, but when we have five terrible ones in about two weeks, and have crews out looking for two missing air liners at the same time, it is getting a bit too thick."

The letter was fully discussed by the Board and it was decided to print it as above with full endorsement, with only this minor revision—that pilots themselves are not free from blame. Naturally, they have to take flying pay under consideration, and want to go through in all types of weather. Nor will they travel out of their way to avoid storms.

Of course, the pilots themselves take the risk, but perhaps familiarity leads them to underestimate the risks involved.

COLONEL RICKENBACKER'S LETTER

The accidents as referred to above have caused immense discussion in the press. Announcement of a forthcoming conference between operators and the Department of Commerce has been made, and there has been an exchange of letters between Colonel E. V. Rickenbacker, General Manager of Eastern Air Lines, and Colonel J. M. Johnson, Assistant Secretary of Commerce. The Board unanimously adopted as its own recommendations, the recommendations made by Colonel Rickenbacker.

"(a) That the Department of Commerce make every effort to modernize and raise to the highest standard of efficiency, all of its present air aids, as soon as Congress appropriates the necessary money.

"(b) That all modern air transports be equipped with radio compasses qualified to operate both day and night with antennas shielded against rain, sleet and snow static.

"(c) That the Department of Commerce equip all of its ground stations with T-L antennas offering the transport ships in the air a twenty-four hour a day service, with special identification for each city or airport, where the facilities of the Department are located, eliminating the necessity, as at present, of using commercial stations which are not consistent in announcing their designations, or on the air twenty-four hours a day.

"(d) That all Department of Commerce radio stations be equipped with personnel qualified to man them twenty-four hours a day and with radio direction finders on special frequencies that may be trained on any operator's ship which may be temporarily lost due to unusual circumstances or conditions, giving them their exact location through the triangulation system, and directing them to the nearest airport that is open."

In addition to the adoption of Colonel Rickenbacker's recommendations, the Board offered the following suggestions to airline operators:

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Improve their own radio equipment;

Expedite the installation of de-icing equipment;

Undertake immediately to give their pilots greater assistance for instruction in blind flying, radio, and other aids to navigation.

CAN THE TRANSPORT AIRPLANE BE IMPROVED?

The acting Chairman, while thoroughly in sympathy with the above recommendations on the avoidance of accidents, brought up this very important point—Is it not possible that the transport airplane itself could be somewhat improved to take care of crash conditions?

Mr. Wilford was perfectly in accord with the increased restrictions of flying in bad weather, improvement of all Department of Commerce and airline personnel, but said he had seen little discussion for the improvement of the airplane itself. "When an airplane has lost its way," quoting Mr. Wilford, "or is required to make a forced landing, all these other subjects fade into the background.

"The important factors are how to improve the present equipment to withstand landing in wooded country, controllability with one motor impaired; and in event that a crash is unavoidable, to have the pilots and passengers so surrounded by the major structure of the aircraft that nine chances out of ten the personnel are protected, instead of the reverse, which is now true."

Mr. Burnelli, an honored visitor, whom the Board was very glad to have participate in the discussion, supplemented Mr. Wilford's views by discussion of the characteristics of the fuselage in a crack-up.

The engine fuselage gave way to the all-metal fuselage because of its lack of strength under crash conditions. Is it not possible that special attention should be

(*Concluded on page 68*)

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1/4x1/4	.05
1/4x1/2	.06
1/4x1	.10
5/16x5/16	.06
3/8x3/8	.09
1/2x1/2	.13
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Air Board

(Continued from page 66)

paid by designers to increase structural strength of the fuselage and engine assembly, so as to provide maximum protection to the occupants in event of the most serious crack-up?

SAFE ALTITUDES IN FLYING

A picture sent in by Mr. Randolph F. Hall showed a plane caught in a tree top in the heart of a New York State city. With the ever increasing number of planes aloft, should not pilots seek more and more to avoid populous districts? Quite a number of recent accidents have resulted in crashes into houses. Also it is not uncommon for pilots to fly at low altitudes in populous districts when there is apparently no reason whatsoever for such hazardous flying.

CONGRATULATIONS TO THE NEW YORK STATE AVIATION ASSOCIATION

There has been in the past much criticism of State legislation regarding aviation. Such legislation has in many instances placed increased financial burden on the industry, and brought duplication of duties between the Federal and State authorities.

At least, the proposed Aeronautics Act that will shortly be discussed by the New York State Assembly and Senate, is not just another haphazard proposal, but has been carefully drawn up by the New York State Aviation Association. This Association is to be congratulated on the care and hard work it has put into the preparation of this legislation.

While the new Act will call for the establishment of a Commission, its purpose will be to aid aviation in New York State, to coordinate State laws with Federal laws, to cooperate with Federal bodies rather than duplicate their functions, and, in general, to avoid the errors previously mentioned. The Air Board recommended that similar bodies in other States exercise equal vigilance in guiding and fostering appropriate legislation.

END

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Nine Chapters, 66 illustrations of dirt, midget, and championship cars and drivers. How to build fast cars and bodies; 14 plates working drawings. Converting stock cars to 135 m. p. h. racers. Book answers all questions on speeding up cars, balance, speed, revs, rules, specifications, track records, etc. Postpaid $1.00. C. O. D. $1.12. Order NOW. Ray Kuns, Dept. E-3, Cincinnati, Ohio.

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Howard DGA-8

(Continued from page 22)

protection, a construction that avoids the necessity of recovering for the entire life of the plane.

Manually operated flaps, aerodynamically balanced, provide safety in making landings and a safety release is so arranged that, in the event of overshooting, the flaps automatically raise when the throttle is opened and when the speed is increased. They return to the "down" position again as soon as the throttle is closed or the speed is decreased for the next attempted landing.

The use of a heavy wing loading, 20.48 pounds per square foot, insures smooth flying at high speeds in rough air. The riding comfort due to this factor is comparable with that of an airliner and yet safe landings can be made at low speed because of the flap construction.

Dual controls of the automobile type project through the instrument panel and by special design of the control mechanism all unnatural vertical movements of the wheel have been avoided. Stirrup type rudder controls are used with toe operated hydraulic brakes and parking set. This is the type of brake used on most of the airliners and on Army and Navy planes. The floor is clear of all obstructions.

This plane is the final result of 17 years of experimentation with various types of planes and of several years of continuous airline piloting. Its fine flying characteristics and performance have been commented upon by many experienced pilots.

END

Winter Flying Demands

comfortably warm clothing and accessories. These bargains will help you forget the weather.

REGULATION COAST GUARD JACKET
This jacket meets specifications of the United States Coast Guard. It is made for maximum comfort and plenty of warmth. Lined with airplane cloth, zipper front and two roomy pockets. The outside is waterproof jungle cloth. Only $9.00

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This mask covers the entire face and chin. Removable mouth piece. Specially constructed nose feature permits free breathing. Tailored to last! Priced for clearance $2.50

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Resistal. The guaranteed non-shatterable. Optically safe. Fur trimmed. A few left at.....$3.00

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D.E.K. WIDE VISION GOGGLES
(Silk Chenille Binding)
Light and easy to wear. Binding is of triple weight chenille. Shatterproof lenses. Aluminum frame with strong hinge and wide headband. A real buy at $3.00

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If you like to wear a pair of extra light goggles, you will like the W.Y.D. Strong frame. Wide elastic headband. Don't pass these up at.....$1.75

ORDER Send check or money order at once to take advantage of the above Bargains which are specially priced to reduce stock. If C. O. D. slight additional charge for postage. Give head size for helmets. TODAY

AVIATION PRODUCTS CO.
619 S. Federal St., Dept. P.A. 2, CHICAGO, ILL.

Fittings

(Continued from page 42)

B is moved to C and the other end of the strut is fastened to the point D, a fixed part of the shock-strut, they have to be parallel to A-A.

Nevertheless, if the hinge C is connected with E then all axes have to be parallel with F-F; adding a universal will not remedy any error. If torsional motions are present a ball and socket design must be used.

For length adjustment of tubes or struts a threaded barrel, see Sec. 24, is the simplest but not the best design.

END

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The School the AVIATION Industry Calls on for TRAINED MEN
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50c *10c Postage*

REARWIN SPEEDSTER

75c *10c Postage*

Wing Span 16" Length ...10"

CAPT. MOLLISON'S BELLANCA RACER

1.00 *10c Postage*

WING SPAN....20" LENGTH .....12¼"

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LOCKHEED ORION

Wing Span..20" Length ...12¾"

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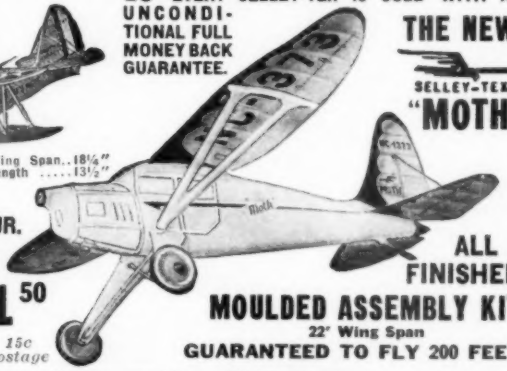
Wing Span..18¼" Length .....13½"



THE NEW SELLEY-TEX "MOTH"

VOUGHT CORSAIR, JR.

1.50 *15c Postage*

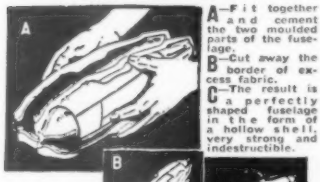
WING SPAN..18" LENGTH ...13¾"

1.25 *15c Postage*

EVERY SELLEY-TEX KIT CONTAINS

The necessary moulded fuselage shells, cowl, parts, bombs, motor, etc. Sawcut propeller, scale propeller parts, formed wire hooks, scaled wheels, brass bushings, printed out ribs on balsa, turned wood parts, tail wheel fork fittings, wire, para rubber motor, colored paper, authentic markings, colored insignia, cement, colored dopes and easy to understand plans, and are packed in a beautiful sturdy box.

SIMPLE AS A, B, C.



A—Fit together and cement the two moulded parts of the fuselage.

B—Cut away the border of excess fabric.

C—The result is a perfectly shaped fuselage in the form of a hollow shell, very strong and indestructible.

Send 5c for catalog of Airplane Supplies, 5c for Boat Catalog.

CHECK these 10 Advantages Selley-Tex Offers Over All-Balsa-Stick-Kits

1—HOLLOW MOULDED CONSTRUCTION.
2—EASIER TO BUILD.
3—PRACTICALLY CRASHPROOF.
4—MORE AUTHENTICALLY DESIGNED AND DETAILED.
5—POSITIVE MEANS OF BALANCING.
6—BETTER FLYERS.
7—SUPERIOR FINISH.
8—NON-COMPETITIVE.
9—PATENTED.
10—EVERY SELLEY-TEX IS SOLD WITH AN UNCONDITIONAL FULL MONEY BACK GUARANTEE.

ALL FINISHED MOULDED ASSEMBLY KIT

22" Wing Span

GUARANTEED TO FLY 200 FEET

This trim, graceful new SELLEY-TEX sensation is a modified design of the famous English "DeHAVILAND-MOTH" and is the most beautiful flying model ever produced. FOR THE FIRST TIME, since the inception of MODEL Building SELLEY has accomplished that which has been the goal of all model manufacturers. HERE AT LAST—is a super quality model that is scientifically designed and aerodynamically perfect that will give amazingly long flights, either from the hand or off the ground. The method of construction and new uses of materials are entirely novel and new in model airplane building. All parts of the Moth are beautifully moulded in the form of light hollow shells, perfectly shaped and fully detailed. The fuselage shells are firmly fused together forming a perfect, crashproof fuselage. All wing surfaces are moulded to the correct wing curves and are completely finished. The moulded hollow streamline struts are remarkably strong when cemented together. The "MOTH" when assembled is practically crash proof and will stand up under the most severe flying punishment.
The Moth is attractively and completely finished in a combination of three beautiful colors. Be the first to fly the MOTH in your neighborhood. ASK YOUR DEALER—if he can't supply you send direct $1.50 plus 15c postage.

● WHAT IS SELLEY-TEX? ●

SEELEY-TEX is a finely woven processed fabric, moulded in form stiff hollow shells reproducing in perfect detail, fuselages, cowls, motors, pants, etc. It is half as light and twice as strong as any balsa model with the same amount of detail.

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1¼" long B 25c
1⅝" long A 30c

SWIVEL TYPE GUNS C
2" Double Action 15c

PURSUIT TYPE GUNS D
¾" long.....5c
1" long.....5c
1½" long.....5c

TYPE E
1¾" long....10c

TYPE F
1¾" long 10c

G DUMMY RATCHET GUN
⅞" long 5c
3c Postage

13/16" ... 5c
1¼" 8c
3" Torpedo.15c

DUMMY MOTORS

Something New
3 Cylinder
1" dia. 30c
1½" dia. 50c

Spun Aluminum COWLS

	Drag Ring	Open Face	Closed Face
1"	.15	.15	.15
1½"	.18	.18	.18
2"	.20	.20	.20
3"	.28	.28	.28

Authentic 2¼"x4¼" Airplanes

24 ARMY	.25c Set
18 NAVY	.25c Set
16 WARTIME	.25c Set
84 SQUAD. INSIG.	.25c

PROPELLERS

Hawk Type 2-bladed		Hawk Type 3-bladed		DIE CAST 2-bladed		Standard 3-bladed	
3½"	.25c	4"	.35c	2"	.10c	1½"	.10c
4"	.30c	4½"	.45c	1½"	.8c	2½"	.12c
4½"	.35c	5"	.50c	2½"	.10c	4"	.25c
5"	.35c	5½"	.60c	3½"	.15c	4½"	.35c
5½"	.40c	6¼"	.70c	4"	.20c	5"	.45c
6¼"	.40c	7"	.80c	4½"	.25c	6"	.60c
7"	.55c	8"	.90c	5"	.30c	7"	.70c
8"	.65c	9"	$1.00	5½"	.35c	8"	.80c
9"	.75c	10"	1.10	6"	.40c	9"	.90c
10"	.85c	11"	1.25	6½"	.45c	10"	$1.00
				6¾"	.50c		

Props can be had up to 24 in. dia. Postage 6c each.

CELLULOID MOTORS

Postage 3c

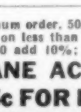
Separate Cylinders		Celluloid Dia. Motors		Aluminum Cowl Plates		Celluloid Motor & Cowl Combinat'n	
5/16"	.3c	1½"	.25c	⅞"	.8c	1½"	.25c
⅜"	.4c	2"	.30c	1¼"	.10c	2"	.30c
⅝"	.5c	3"	.35c	1¾"	.12c	3"	.35c

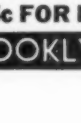
Dummy Turnbuckles

¼" .....10c each ⅜" .....10c each ½" .....10c each

WHEELS

SEND 5c FOR CATALOG





Aluminum Disc Rubber Tired Wheels

½" dia. .... 5c ea.
⅝" dia. .... 6c ea.
⅝" dia. .... 7c ea.
⅞" dia. .... 8c ea.
1" dia. .... 9c ea.
1⅛" dia. ....10c ea.
1¼" dia. ....11c ea.

Balloon Tire Alum. Disc Wheels

1½" dia. ....25c pr.
1⅝" dia. ....28c pr.
2" dia. ....30c pr.

Treaded Rubber Tire Aluminum Disc

1 3/16" dia..30c pr.
1½" dia. .. 40c pr.
2" dia. ....50c pr.
3" dia. .. 60c pr.
3⅝" dia. ...$1.50 pr.
6½" dia. ...$2.00 pr.
7" dia. ...$2.50 pr.

Axle Fork and Swivel Joint

½ up to ⅝" wheel 10c
¾ up to ⅞" wheel 15c

Aluminum Disc Rubber Tired Air Wheels

1" dia. ....15c pr.
1¼" dia. ....18c pr.
1½" dia. ....20c pr.

Celluloid Wheels	Balsa Wheels
⅝" dia.06c pr.	.04 pr.
1" dia.08c pr.	.05 pr.
1⅜" dia.10c pr.	.07 pr.
1⅞" dia.18c pr.	.10 pr.
3" dia.35c pr.	.35 pr.

Balloon Tired Celluloid Disc Wheel

1½" dia. ....30c pr.
1⅝" dia. ....33c pr.
2" dia. ....35c pr.

AXLES Threaded and fitted with washers, bushings and nuts.

Lengths	1/16	3/32	1/8
2"-5"-6"	12	.10	.20
7"-8"-9"	14	.12	.23
10-11-12"	18	.15	.25

Postage 3c per pair, on Rubber Tired Wheels, 4c pair

IMPORTANT—Minimum order, 50c. Add postage on all items but if over 15c on less than $1.50 order add only 15c. Orders over $1.50 add 10%; west of Denver 15%.

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XUM

Edward's Plane

(*Continued from page 21*)

During the past decade Edward's air travels have extended far beyond the British Isles. Frequently he has flown across the channel to points on the continent, usually in one of his own planes, but occasionally by airliner. In 1931 his use of the airplane during his heralded tour of Latin America vastly impressed the people. One of Edward's own planes, accompanied by his personal pilot, was taken by aircraft carrier to Buenos Aires for use on the tour. The impression made at this time has had a great deal to do with the subsequent increase in the use of air transport in Latin America .

For several years Flight Lieutenant Edward H. Fielden has been Edward's chief personal pilot. He is 33 and one of the Empire's crack flyers, having won in 1929 for meritorious peace-time flying the rare honor of the Air Force Cross. Last summer, during Edward's reign, he was formally made a member of the King's Household.

Flight Lieutenant Fielden piloted the Dragon-Rapide in which Edward flew to London the day he ascended the throne. Thereby the lieutenant gained for himself the historical distinction of being the first man ever to pilot a British monarch through the air.

END

Multi-Spar

(*Continued from page 38*)

Daniel Guggenheim school of Aeronautics shares this opinion. In a letter to the Commander he said:

"American airlines are already provided with suitable equipment in the form of ships carrying from 14 to twenty passengers. The smaller lines and feeder lines have at the time no suitable equipment available. A small single engine plane does not provide the requisite safety, nor does it provide sufficient passenger carrying capacity. Single engine machines have been disapproved by the Department of Commerce for night operation.

"On the feeder lines, just as on the main lines, there must be made available a twin engine machine capable of flying on one engine. There must further be provided for such work at least six passenger seats, with baggage and adequate fuel for the necessary range. I can quite definitely state there is no machine at present on the American market meeting those requirements."

This development is quite interesting in view of its importance to the structural design of large planes and results are eagerly awaited.

Lee Gehlbach, nationally known test pilot, has been engaged by the company and will make all the tests on the new transport when completed.

END

Models

(*Continued from page 47*)

The wind shield and celluloid windows are cemented in position after the model has been completely painted.

TESTING AND FLYING

Two types of propellers are used on this model. One is made of fiber, which has a much wider blade, causing the rubber motor to turn at less r.p.m., and enabling the model to fly greater distances. By twisting the blades, the pitch can be easily adjusted.

The balsa scale propeller is used for exhibition purposes only.

Six strands of ⅛" flat rubber are sufficient to fly the model.

With the rubber motor and flying propeller in place, gently launch your model over tall grass to see whether it is properly balanced.

If model glides a short distance and nose rises abruptly, it will be necessary to add weight to the bottom of the nose. If model dives, add weight to tail.

After the model is balanced to glide at an even angle, you are ready to test your model under power.

A few trial flights will acquaint you with your model.

END

Paris Show

(*Continued from page 20*)

ably improved over those shown in 1934. They now attain a speed of between 250 and 300 miles per hour. The tendency now seems to be towards mid-fuselage low cantilever wings, which improve the aerodynamic qualities of the planes as well as furnish space to retract the landing-carriages and to carry additional military loads. These machines were equipped with Gnome & Rhone K 14 or Hispano-Suiza 1,000 h.p. engines with critical altitudes of from 3,500 to 4,500 meters.

The Caudron-Renault Company presented their line of light postal, tourist and passenger single and twin-engine machines constructed of wood and equipped with inverted in line motors of from 100 to 220 h.p. The Deutsch Cup type single seater racing plane, with which Michael Detroyat won the Thompson and Greve trophies at the Los Angeles meeting last Fall, was also exhibited.

END

The REARWIN Speedster Gas Model

D. C. Davis Reports Sensational Performance!

After his REARWIN had flown 22 miles D. C. Davis, Rocky Ford, Colo., said, "It's a good thing I only had ⅛ of an ounce in the tank, otherwise my Rearwin would have been found in the next state."

Flies 20 M.P.H. Over 30 minutes on ½ oz. gas (capacity 1 oz.). Takes off in 25 feet. Lands at 16 M.P.H. Full Size Plans.

Full size plans, ready cut out ribs, Latest Type M. & M. air wheels, aluminum motor mount, sheet aluminum for cowling, special metal fittings, veneer, all balsa parts cut to correct size, tubing, rods, springs for shock absorbing landing gear and clear and colored dopes. This fine kit is complete down to special bolts, screws and many other parts too numerous to mention here.

Span OVER 6 FT. Length OVER 3½ FT.

The Baby Cyclone or any light model engine can be installed in this Rearwin Model.

HIGH QUALITY and REAL VALUE. COMPLETE KIT..... **$8.75**

New Price Effective February 10, 1937

COMPLETE KIT INCLUDING BABY CYCLONE MOTOR **$24.50**

Add 50c extra to cover cost of packing and mailing.

(West of Mississippi add 10%; Canada, 10%; Foreign, 15%.)

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COLT 45 Cal. "FRONTIER" MODEL $1.45

Basswood construction kit with working plans, machined barrel, cylinder and all necessary hardware.

COLT 45 Cal. "FRONTIER" model kit, 4¾" barrel.	$1.45
COLT 45 Cal. "FRONTIER" model kit, 5½" barrel.	1.55
COLT 45 Cal. "FRONTIER" model kit, 7" barrel.	1.70
COLT 45 Cal. Automatic Pistol kit.....	1.00
Half scale Thompson Sub Machine Gun model kit...	1.00
Full scale Thompson Sub Machine Gun model kit...	3.00
SAVAGE Cal. 32 Auto. Pistol kit, machined barrel..	.75
LUGER Auto. Pistol with 4" machined barrel.....	1.75
LUGER Auto. Pistol with 6" machined barrel.....	1.90
COLT 25 Cal. Automatic Pistol kit.....	.50

These beautiful kits are complete in every detail and made of the best basswood. All parts are cut to shape and require only a short time to finish. Postpaid in U. S. A.

GUN MODEL CO.

Dept. K-2, 2908 N. Nordica Ave. Chicago, Ill.

Wingless

(*Continued from page 26*)

surfaces is 23 sq. ft., while that of the wing is 276 sq. ft., having a span of 22 ft. and a maximum chord of 16 ft. The new "Arup," a two-seater weighs only 675 lbs. empty, which very nearly puts it into the light plane class.

With the 70 h.p. Le Blond engine, the plane had a top speed in its initial run of 88 m.p.h., and a landing speed with one pilot, of 23 m.p.h. A low pitch prop was used to obtain quick takeoffs so as to fulfill the Bureau of Air Commerce requirements for the flivver plane. Using a prop with the correct pitch, the plane is expected to do over 100 m.p.h.

One of the unsolved problems of the "Arup," which, although of minor importance in a test ship, becomes more so if the plane is to be put on the market, is the matter of entry. At present, the pilot must stoop under the wing, dangerously close to the propeller, and climb into an opening which is made by dropping a flap consisting of part of the wing and fuselage.

However, small inconveniences like this are greatly overshadowed by such features as the excellent visibility afforded the pilot, and we can expect to hear more from the "Arup" in the future.

In between "Arups," Hoffman took time out to design and construct his own idea of a low ratio Flying Wing. Since 1912, when he published an article on the "All Wing" airplane, from which was taken the simple paper glider shown in Fig. 9, Hoffman has been experimenting with the Flying Wing idea.

That he is no idle dreamer is proved by the calculating and designing instruments which he has devised. Among these is the triple slide rule, which was used extensively for designing planes during the World War. Of particular interest to model aviation enthusiasts is his Model Airplane Designing Slide Rule. On this can be calculated everything from the prop area to the gliding angle.

In designing his Wing, Hoffman discarded the straight leading edge of the "Arup" as unstable, substituting one with a pronounced sweepback. The plane, a 2-seater with a 22 ft. 8 in. span, a 14 ft. 6 in. chord, and a total wing area of 237 sq. ft., weighed 900 lbs. This weight, according to the designer, can be reduced considerably by more detailed designing.

Although constructed to be retractable, all tests were carried out with a rigid landing gear. Powered by an English Cirrus motor of 85 h.p. the plane showed a takeoff speed of 30 m.p.h., a top speed of 135 m.p.h., and a landing speed of 28 m.p.h.

The controls consist of wing tip ailerons, and twin elevators at the rear. There is a walkway over the top of the wing from the rudder, to facilitate entering the cabin which is comfortably roomy. Visibility is not as good as in most machines, due to the fact that the pilot sits very low in the fuselage. The absence, however, of a well defined hump, and sharply angled windshield lessen the parasitic drag and make for better performance.

And so we conclude our list. But who knows what tomorrow will bring in the way of new developments. The urge for healthy experimentation is fast being reborn in the Aviation world. Perhaps the perfect airplane is, like several well known dreams, just around the corner. But, seriously, while we can only seek, and never attain, perfection, certain it is that we must be open to new ideas and theories, if we are to approach the ultimate in performance to any marked degree.

As a disinterested commentator, I should like to review those characteristics of the Flying Wing which place it so far ahead of the usual types.

Important, is the wonderful *natural stability* possessed by such a craft. While some models can be spun, they all recover automatically without the assistance of the pilot. When flown into a stalling position, these planes level out and can be said to "mush" downward a short distance under complete control, till speed is restored. This behavior is caused mostly by the upturned trailing edge at the wing tip, or, as in some ships, their equivalent.

Because of this air foil, in normal flight an air load is carried behind the center of gravity. If the angle of attack is increased, the center or front portion of the wing stalls first; at the same time, the upturned tips lose their air load and create lift, thereby bringing the plane back to an even keel. In the same way, if the plane dives, the air load on the tips increases as the angle of attack is reduced.

END

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Diamond is one of the "pioneer" model airplane supply houses. One of the first in business—first with new ideas for model plane builders—always first with the lowest prices.

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IF 18" LENGTHS ARE DESIRED, TAKE ½ OF 36" LENGTH PRICE.
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1/32x1/16 ..... .10
1/16x1/16 ..... .10
1/16x1/8 ..... .20
1/16x3/16 ..... .23
1/16x1/4 ..... .27
3/32x3/32 ..... .25
1/8x1/8 ..... .30
1/8x3/16 ..... .50
1/8x1/4 ..... .55
1/8x3/8 ..... .65
3/16x3/16 ..... .50
3/16x1/4 ..... .60
1/4x1/4 ..... .85
1/4x3/8 ..... 1.25
1/4x1/2 ..... 1.60
3/8x3/8 ..... 1.90
1/2x1/2 ..... 2.25

BALSA SHEETS
36" Lengths

1/64x2, 10 for... .14
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3/32x2, 10 for... .21
1/8x2, 10 for..... .23
3/16x2, 10 for..... .32
1/4x2, 10 for..... .42
1/2x2, 10 for..... .75
If 3" Widths Are Desired, Double Price of 2" Widths.

FRESH PARA RUBBER
AAA Grade
1/32 sq., 225' skeins ..... .20
.045 sq., 225' skeins ..... .30
3/32 flat, 225' skeins ..... .30
⅛ flat, 225' skeins ..... .35
3/16 flat, 225' skeins ..... .55
Per Pound, any size ..... .80

INSIGNIA SHEET
12 pr. & rudder and tail markings with gummed back.
12 Sheets..... .36
50 Sheets..... 1.25
100 Sheets..... 1.75

SANDPAPER
5 Pieces to the Pack
Per doz. pkgs.... .25

BALSA PLANKS
36" Lengths

1x1, each ..... .06
1x1½, each .... .09
1x2, each ..... .15
1x3, each ..... .20
1x6, each ..... .35
1½x1½, each.. .25
2x2, each ..... .25
2x3, each ..... .35
2x4, each ..... .45
2x6, each ..... .60
3x6, each 1.25

STANDARD PITCH BALSA PROPELLER BLOCKS
Per Dozen

½x¾x5 ..... .05
½x¾x6 ..... .06
¾x1x7 ..... .12
¾x1x8 ..... .16
⅞x1x9 ..... .23
⅞x1¼x10 ..... .25
⅞x1¼x12 ..... .30
1x1½x12 ..... .35
1x1½x15 ..... .50

BAMBOO
1/16 sq. x 14.
1 gross for.... .10
1/16x¼x11.
1 doz. for..... .05
1/16x¼x11.
1 gross for.... .45

REED

1/32 dia...50 ft. .15
1/16 dia...50 ft. .18
3/32 dia...50 ft. .20
⅛ dia.....50 ft. .25

DOWELS
1/16 dia. x 12".
100 for .... .55
25 for ..... .20
⅛" dia. x 36".
100 for 1.50
25 for ..... .45
3/16 dia. x 36".
100 for 2.25
25 for ..... .75
¼" dia. x 36".
100 for 3.00
25 for 1.00

WOOD VENEER
(For scale model work)
20"x30", 3 sheets for ..... .25

COLORLESS CEMENT
1-oz., per ½ doz. .22
2-oz., per ½ doz. .40
4-oz., per ½ doz. .70
1 pt., each..... .40
1 qt., each..... .70
1 gallon 1.75

SPECIAL COLORLESS CEMENT
1 gallon, each.. 2.00

CLEAR DOPE OR BANANA OIL
1-oz., per ½ doz. .22
2-oz., per ½ doz. .40
4-oz., per ½ doz. .70
1 pt., each..... .35
1 qt., each..... .65
1 gallon, each.. 1.50
Thinner same price as clear dope.

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A Beautiful Pedestal for Your Airplanes
Per dozen ..... .48

SPECIAL CLEAR DOPE
1 gallon, each.. 1.75

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To shine up colored models.
1-oz., per ½ doz. .30
2-oz., per ½ doz. .55
4-oz., per ½ doz. 1.00

COLORED DOPE
White, yellow, orange, blue, red, green, olive, drab, black, silver, gold or gray.
1-oz., per ½ doz. .25
2-oz., per ½ doz. .45
4-oz., per ½ doz. 1.00
1 pt., each..... .40
1 qt., each..... .75
1 gallon, each.. 2.00

TISSUE "AA" QUALITY WHITE
20 x 24
1 doz. ..... .10
½ ream 2.00
1 ream, 500 sheets 3.75

TISSUE "AA" QUALITY COLORED
20x24
Red, blue, black, orange, green, yellow, olive, drab.
1 doz. ..... .15
½ ream 3.00
1 ream, 500 sheets 4.50

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Per doz. sheets.. .21

GENUINE SUPER-FINE TISSUE
(Cover your champion endurance ships with this paper.)
18x24, per doz.... .50

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.0003 of an inch thick. 3½" wide, 100 ft. for ..... .35

SHEET ALUMINUM
.002 thick, 5 ft. for ..... .35
.010 thick, 5 ft. for ..... .50
.015 thick, 5 ft. for ..... .75

ALUMINUM TUBING
(Special 1/100" wall.)
1/16 O.D., 5 ft. .28
3/32 O.D., 5 ft. .30
⅛ O.D., 5 ft.... .30
3/16 O.D., 5 ft. .38
¼ O.D., 5 ft.... .43

CELLULOID WHEELS
¾" per doz. wheels ..... .21
1" per doz..... .22
1⅜" per doz.... .31
1⅞" per doz.... .55

BALSA BALLOON WHEELS
(Machine Turned)
½" dia., per doz. .09
¾" dia., per doz. .11
1" dia., per doz. .14
1¾" dia., per doz ..... .19
1⅞" dia., per doz. ..... .35
3" dia., per doz. .75

BIRCH WHEELS LIGHT & STRONG
½"..... per doz. .05
¾"..... per doz. .06
1"..... per doz. .08
1⅜"..... per doz. .10
1⅞"..... per doz. .15

WASHERS PER 100
⅛ brass O. D.....05
½ copper O. D....05

BRASS BUSHINGS OR EYELETS
1/16 dia..per 100 .12
3/32 dia..per 100 .15
⅛ dia.....per 100 .18

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(Celluloid, 9 cyl.)
1½", 1 doz. for.. .35
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3", 1 doz. for... .60

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Per 100 ..... .75

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100 ..... .40
Large, per doz.... .10
Per 100 ..... .75

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Per gross ..... .75

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Per gross ..... .75

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Ready for final sanding. To fit:
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¾" wheels, 6 pr. .36
1" wheels, 6 pr. .36
1⅜" wheels, 6 pr. .54
1⅞" wheels, 6 pr. .54

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(Hard Steel)
Small, per doz... .06
Small, per gross. .50
Large, per doz... .07
Large, per gross. .65

WIRE, PER 100 FT.
(Straight Lengths)
6 ..... .20
8 ..... .23
10 ..... .25
12 ..... .27
14 ..... .30

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(Die Cast)
1½" long, 3 for. .16
2½" long, 3 for. .14
3½" long, 3 for. .18
4½" long, 3 for. .22

3-BLADED PROPS
(Die-Cast)
1½" long, 3 for. .12
2½" long, 3 for. .16
3½" long, 3 for. .20
4½" long, 3 for. .26

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2½", 3 for..... .50

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5".....per doz. .22
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7".....per doz. .35
8".....per doz. .38
9".....per doz. .40
10".....per doz. .50
12".....per doz. .60

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2 1/2" Browning ...pair 25c
1 1/2" Marlin .....pair 10c
2" Marlin .....pair 25c
1 5/8" Spandau ....pair 10c
1 3/8" Vickers .....pair 12c

LEWIS GUNS

1 3/8" long 15c
2" long 20c
1" long 5c

MACH. GUN MOUNT

For 2" Marlin Gun..pair 5c
½" Tail Wheel Fork...5c

DEMOLITION BOMBS

⅞" long .....pair 5c
1 1/4" long .....each 10c
1 1/2" long .....each 12c
1 1/8" Fragmentation Bomb .....each 5c

CONTROL HORNS

½" long Set of 6.....20c
⅜" long Set of 6.....25c

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1" dia. 9 cylinder...20c
1 1/4" dia. 9 cylinder...30c
2" dia. 9 cylinder...50c

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For 1" dia. 9 cyl. motor.10c

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2 BLAD.		2 BLAD.		3 BLAD.	
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3"	ST.....15c	4"	SP.....30c	2 1/2"	ST.....15c
4"	ST.....20c	6"	SP.....50c	3"	ST.....20c
5"	ST.....25c	2"	W.....10c	4"	ST.....30c
6"	ST.....30c	2 1/2"	W.....15c	5"	ST.....40c
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3/4"	.85
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1 3/4"	2.00

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Designing Control Surfaces

(*Continued from page* 46)

Data has been compiled proving that with one aileron up and the other down at the same angle, the rolling moment is greatest at the low angles of attack and the aileron that is up gives the most rolling moment, the difference increasing with the larger angles.

This characteristic led to the development of the differential aileron. This serves much the same purpose as the differential in the automobile. In this case, the aileron that moves up passes through a greater angle than the one that moves downward.

Any ratio may be used, possibly 2:1 being a favorable ratio. This type of aileron is very useful on lightplanes provided a simple, rugged mechanism can be designed, since it is not only more effective in producing a proper rolling moment, but also gives a smaller amount of yawing.

As previously stated, the effort on the part of the pilot to operate a control surface should be a minimum. For this purpose the "balanced" aileron is sometimes used. These surfaces, for the most part, are only used on slow airplanes.

The overhung type of balance was used during the War on both German and some English planes. (See Fig. 3.) In this case the area front of the hinge was about 12 percent of the area of the aileron. In the "paddle" type of balance about 20 percent was ahead of the hinge line. It is apparent that these types of surfaces develop tremendous loads which are undesirable, as previously explained.

There is one type of balanced surface, the "Handley-Page" type, which has been used recently. In this case about 25 percent of the area is forward of the hinge. This surface is satisfactory on high speed planes being used on some military jobs.

The Frise aileron is a type much used on many of our successful lightplanes of today. Their chief accomplishment is that a reduction of yawing moments caused when the ailerons are moved is noted. Fig. 4 shows a sketch of this aileron.

It can be seen that this aileron employs a form of balancing, that is, an inset-hinge is used. Another method of hinging this aileron is illustrated in Fig. 5a. In this case the aileron is not cut for an inset-hinge.

In this type of aileron if the right one is turned down, the upper leading edge is screened behind the top camber of the airfoil. The lower leading edge on the other aileron would project below the lower surface of the wing and therefore increase the drag on that side, neutralizing the increased drag on the right side, thus reducing the yawing moments. This type of aileron has been used on some racing planes.

There are certain structural points to be considered when doping out the ailerons.

Note that the hinge line should always be on the top surface of the wing, the reason for this being, that if the hinge is located at another point, large gaps will be necessary and the efficiency of the wing is reduced as well as the drag being greatly increased. See Fig. 5b.

It is to be noted also that with the hinge on the top surface, a form of differential control is the result. Some designers put flaps over the gap to reduce the drag but in a lightplane its effect is not pronounced. Also, there should be at least three hinges on each aileron and some prefer four.

As to the constructional features of ailerons, modern practice seems to dictate tube construction. Ailerons made of tube are light and stronger than those of wood.